BLM LIBRARY
88049702

IMPERIAL PROJECT
IMPERIAL COUNTY, CALIFORNIA

DRAFT
ENVIRONMENTAL IMPACT STATEMENT/
ENVIRONMENTAL IMPACT REPORT

VOLUME II
(Appendices B - L)

State Clearinghouse No. 95041025

NOVEMBER 1996

Prepared By:

Bureau of Land Management
El Centro Resource Area
El Centro, California

County of Imperial
Planning/Building Department
El Centro, California

Environmental Consultant
Environmental Management Associates, Inc.
Brea, California

ID 88649702

TN
243
.C2
I564
1996
V.2

IMPERIAL PROJECT
IMPERIAL COUNTY, CALIFORNIA

DRAFT
ENVIRONMENTAL IMPACT STATEMENT/
ENVIRONMENTAL IMPACT REPORT

VOLUME II
(Appendices B-L)

State Clearinghouse No. 95041025

November 1996

Applicant

Chemgold, Inc.

BLM LIBRARY
HQ 150A BLDG. 50
DENVER FEDERAL CENTER
P.O. BOX 25047
DENVER, CO 80225

Prepared By

Bureau of Land Management
El Centro Resource Area
El Centro, California

County of Imperial
Planning/Building Department
El Centro, California

LIST OF APPENDICES

The following Appendix is contained in Volume I of the Draft EIS/EIR:

APPENDIX A	CHEMGOLD, INC. IMPERIAL PROJECT RECLAMATION PLAN

The following Appendices are contained in this Volume II of the Draft EIS/EIR:

APPENDIX B	SCOPING DOCUMENTS
APPENDIX C-1	CHEMGOLD, INC. IMPERIAL PROJECT WASTE CHARACTERIZATION STUDY
APPENDIX C-2	CHEMGOLD, INC. IMPERIAL PROJECT SUPPLEMENTAL WASTE CHARACTERIZATION STUDY
APPENDIX D	WATERS STUDY, CHEMGOLD INC., IMPERIAL PROJECT, IMPERIAL COUNTY, CALIFORNIA
APPENDIX E-1	HYDROLOGY BASELINE REPORT FOR THE IMPERIAL PROJECT IMPERIAL COUNTY, CALIFORNIA
APPENDIX E-2	SUPPLEMENTAL HYDROLOGY STUDY FOR THE IMPERIAL PROJECT IMPERIAL COUNTY, CALIFORNIA
APPENDIX F	VEGETATION BASELINE SURVEY, IMPERIAL PROJECT, IMPERIAL COUNTY, CALIFORNIA
APPENDIX G	BIOLOGICAL SURVEY REPORT, CHEMGOLD IMPERIAL PROJECT, CALIFORNIA
APPENDIX H	POSSIBLE BAT OCCURRENCES ON THE CHEMGOLD IMPERIAL PROJECT SITE
APPENDIX I	DESERT DEER AND THE CHEMGOLD IMPERIAL PROJECT
APPENDIX J-1	CULTURAL RESOURCES INVENTORY OF INDIAN PASS: AN INVENTORY AND EVALUATION FOR THE IMPERIAL MINE PROJECT, IMPERIAL COUNTY, CALIFORNIA
APPENDIX J-2	A SUPPLEMENTAL CULTURAL RESOURCES INVENTORY AND EVALUATION OF THE POWER SUPPLY ROUTE FOR THE IMPERIAL PROJECT, IMPERIAL COUNTY, CALIFORNIA
APPENDIX K	VISUAL CONTRAST RATING SHEETS
APPENDIX L	CHEMGOLD IMPERIAL PROJECT AIR QUALITY ANALYSIS

BLM LIBRARY
RS 150A BLDG. 50
DENVER FEDERAL CENTER
P.O. BOX 25047
DENVER, CO 80225

APPENDIX B - SCOPING DOCUMENTS

APPENDIX B

This Appendix contains the following documents relating to the scoping process for the Imperial Project Environmental Impact Statement/Environmental Impact Report:

- Federal Register publication of the Notice of Intent (NOI) to Prepare and Environmental Impact Statement (EIS) on a Proposed Gold Mining/Processing Operation
- Imperial County Planning and Building Department Notice of Preparation (NOP) of a Draft Environmental Impact Report, including distribution list
- Comment letters received in response to the NOI or NOP
- Discussion of Notice of Intent/Notice of Preparation Comment Documents Received, including documentation of the comments received at the public scoping meetings

The applicant proposes to compensate for this incidental take of golden-cheeked warbler habitat by placing $1,500 into the City of Austin Balcones Canyonlands Conservation Fund to acquire/manage lands for the conservation of the golden-cheeked warbler.

Alternatives to this action were rejected because selling not developing the subject property with federally listed species present was not economically feasible.

James A. Young,

Acting Regional Director, Region 2, Albuquerque, New Mexico.

[FR Doc. 95-7315 Filed 3-23-95; 8:45 am]

BILLING CODE 4510-55-M

Bureau of Land Management

[CA-060-05-7122-09-6606]

Notice of Intent to Prepare an Environmental Impact Statement (EIS) on a Proposed Gold Mining/Processing Operation

AGENCY: Bureau of Land Management, Interior.

ACTION: Notice of intent.

SUMMARY: Pursuant to Section 102(2)(c) of the National Environmental Policy Act of 1969, the Bureau of Land Management (BLM) will be directing the preparation of an environmental impact statement (EIS) by a third party contractor on the impacts of a proposed gold mining/processing operation known as the Imperial Project, which would be located on public lands in Imperial County in southern California. Comments are being requested to help identify significant issues or concerns related to the proposed action, to determine the scope of the issues (including alternatives) that need to be analyzed, and to eliminate from detailed study those issues that are not significant. Supporting documentation should be included with comments recommending that the EIS address specific environmental issues.

DATES: For Scoping Meetings and Comments: Public scoping meetings will be held on the following dates: 7 pm PST, Monday, April 17, 1995, at the El Centro Community Center, 375 South First Street, El Centro, California 92243; 7 pm MST, Tuesday, April 18, 1995, at the Best Western Yuma Inn Suites, Palm Canyon Room, 1450 Castle Dome Avenue, Yuma, Arizona 85365. Written comments must be filed no later than Friday, April 21, 1995.

ADDRESSES: Written comments should be addressed to Area Manager, Bureau of Land Management, El Centro Resource Area, 1661 South Fourth Street, El Centro, California 92243. ATTN: Environmental Coordinator.

FOR FURTHER INFORMATION CONTACT: Thomas F. Zale (619) 337-4400

SUPPLEMENTARY INFORMATION: Chemgold, Inc., a wholly-owned subsidiary of Glamis Gold, Inc., submitted a Plan of Operation to the BLM's El Centro Resource Area office for the proposed Imperial Project in December, 1994. The project would be located on unpatented lode claims south of the Chocolate Mountains, approximately 45 miles northeast of El Centro, California and 20 miles northwest of Yuma, Arizona, on land administered by the BLM. The project would include mining, waste rock and heap leach facilities, miscellaneous roads and buildings, and reclamation of disturbed lands. The project would consist of up to three (3) open pits, four (4) waste rock stockpiles, one (1) heap leach facility, one (1) water well field and pipeline, one (1) power substation and power line, and one (1) processing facility, and would operate for approximately twenty (20) years. Up to 120,000 tons of ore and waste rock would be mined per day. Processing and reclamation activities would be expected to continue for up to five (5) years after cessation of mining. If approved, approximately 1,600 acres of land would be disturbed and later reclaimed as the result of this project.

A tentative project schedule is as follows:

Begin Public Comment/Scoping Period—March 1995
Hold Public Scoping Meetings—April 1995
File Draft EIS—October 1995
Hold Public Meetings on Draft EIS—November 1995
File Final EIS—January 1996
File Record of Decision—March 1996
Begin Project Construction—July 1996

Dated: March 15, 1995.

G. Ben Koski,

Area Manager.

[FR Doc. 95-6862 Filed 3-23-95; 8:45 am]

BILLING CODE 4310-40-P

[USFS, R-6, 595053; GP5-088; OR-50348 (WASH)]

Order Providing for Opening of Land; Washington

AGENCY: Bureau of Land Management, Interior.

ACTION: Notice.

SUMMARY: This action will open 480 acres of land to surface entry, mining, mineral leasing and geothermal, subject to the laws, rules, and regulations applicable to National Forest System lands. The land has been eliminated from a Forest Service exchange proposal.

EFFECTIVE DATE: April 28, 1995.

FOR FURTHER INFORMATION CONTACT: Pamela Chappel, BLM Oregon/Washington State Office, P.O. Box 2965, Portland, Oregon 97208, 503-952-6170.

SUPPLEMENTARY INFORMATION: Notice is hereby given that pursuant to the General Exchange Act of March 20, 1922 (16 U.S.C. 485, 486), the Federal Land Policy and Management Act of 1976 (43 U.S.C. 1716), and the Federal Land Exchange Facilitation Act of August 20, 1988 (43 U.S.C. 751), the following described Federal land has been eliminated from the initial exchange proposal between the Mt. Baker-Snoqualmie National Forest, and Weyerhaeuser Company, Tacoma, Washington:

Willamette Meridian

T. 13 N., R. 4 E.,
Sec. 10, N½ and SW¼.

The area described contains 480 acres in Lewis County.

At 8:30 a.m., on April 28, 1995, the land will be opened to operation of the public land laws generally, subject to valid existing rights, the provisions of existing withdrawals, and the requirements of applicable law. All valid existing applications received at or prior to 8:30 a.m., on April 28, 1995, will be considered as simultaneously filed at that time. Those received thereafter will be considered in the order of filing.

At 8:30 a.m., on April 28, 1995, the land will be opened to location and entry under the United States mining laws. Appropriation under the general mining laws prior to the date and time of restoration is unauthorized. Any such attempted appropriation, including attempted adverse possession under 30 U.S.C. Sec. 38, shall vest no rights against the United States. Acts required to establish a location and to initiate a right of possession are governed by State law where not in conflict with Federal law. The Bureau of Land Management will not intervene in disputes between rival locators over possessory rights since Congress has provided for such determinations in local courts.

At 8:30 a.m., on April 28, 1995, the land will be opened to applications and offers under the mineral leasing laws and the Geothermal Steam Act.

Dated: March 15, 1995.

Robert D. DeViney, Jr.,

Acting Chief, Branch of Realty and Records Services.

[FR Doc. 95-7160 Filed 3-23-95; 8:45 am]

BILLING CODE 4310-33-P

Notice of Preparation

Appendix J

To: _____
(Agency)

_____
(Address)

_____

Subject: Notice of Preparation of a Draft Environmental Impact Report

Lead Agency:

Agency Name Imperial County Planning/Building Department

Street Address 939 Main Street

City/State/Zip El Centro, CA 92243

Contact Jesse Soriano

Consulting Firm (if applicable):

Firm Name Environmental Management Associates

Street Address 405 State College Blvd., Suite 211

City/State/Zip Brea, CA 92627

Contact Dwight Carey

Imperial County will be the Lead Agency and will prepare an environmental impact report for the project identified below. We need to know the views of your agency as to the scope and content of the environmental information which is germane to your agency's statutory responsibilities in connection with the proposed project. Your agency will need to use the EIR prepared by our agency when considering your permit or other approval for the project.

The project description, location, and the potential environmental effects are contained in the attached materials. A copy of the Initial Study (☐ is ☒ is not) attached.

Due to the time limits mandated by State law, your response must be sent at the earliest possible date but *not later than 30 days* after receipt of this notice.

Please send your response to Jesse Soriano at the address shown above. We will need the name for a contact person in your agency.

Project Title: Imperial Project

Project Location: Eastern Imperial/Indian Pass Road (City (nearest)) Imperial County (County)

Project Description: (brief)

Open pit, heap-leach gold mine. (See attached)

Date April 5, 1995

Signature _____

Title Planning Director

Telephone (619)339-4236 extension 239

Reference: California Administrative Code, Title 14, (CEQA Guidelines) Sections 15082(a), 15103, 15375.

Revised October 1989

ATTACHMENT TO NOTICE OF PREPARATION

TO: TRUSTEE AND RESPONSIBLE AGENCIES AND OTHER INTERESTED PARTIES

FROM: IMPERIAL COUNTY PLANNING/BUILDING DEPARTMENT
939 Main Street
El Centro, California 92243-2856

Contact: Jesse Soriano
Telephone: (619) 339-4236 extension 239
Facsimile: (619) 353-8338

SUBJECT: NOTICE OF PREPARATION OF A DRAFT ENVIRONMENTAL IMPACT REPORT

PROJECT TITLE: Imperial Project

APPLICANT: Chemgold, Inc.

PROJECT LOCATION: Eastern Imperial County approximately 45 miles northeast of the City of El Centro along Indian Pass Road east of Ogilby Road.

The Imperial County Planning/Building Department will be the Lead Agency (pursuant to CEQA Guidelines Section 15051), and will require the preparation of a Project Environmental Impact Report (per CEQA Section 15161) for the project identified below. The document to be prepared will be a joint Environmental Impact Statement and Environmental Impact Report (EIS/EIR). The Bureau of Land Management, El Centro Resource Area (BLM) will be the Lead Agency under the National Environmental Policy Act (NEPA). We request comments from your agency regarding the suggested scope of the EIS/EIR and the identification of potential environmental impacts associated with the project.

Two scoping meetings have been scheduled by BLM as follows:

April 17, 1995, at 7 PM at the El Centro Community, El Centro, California; and,

April 18, 1995, at 7 PM at the Best Western Yuma Inn Suites, Yuma, Arizona.

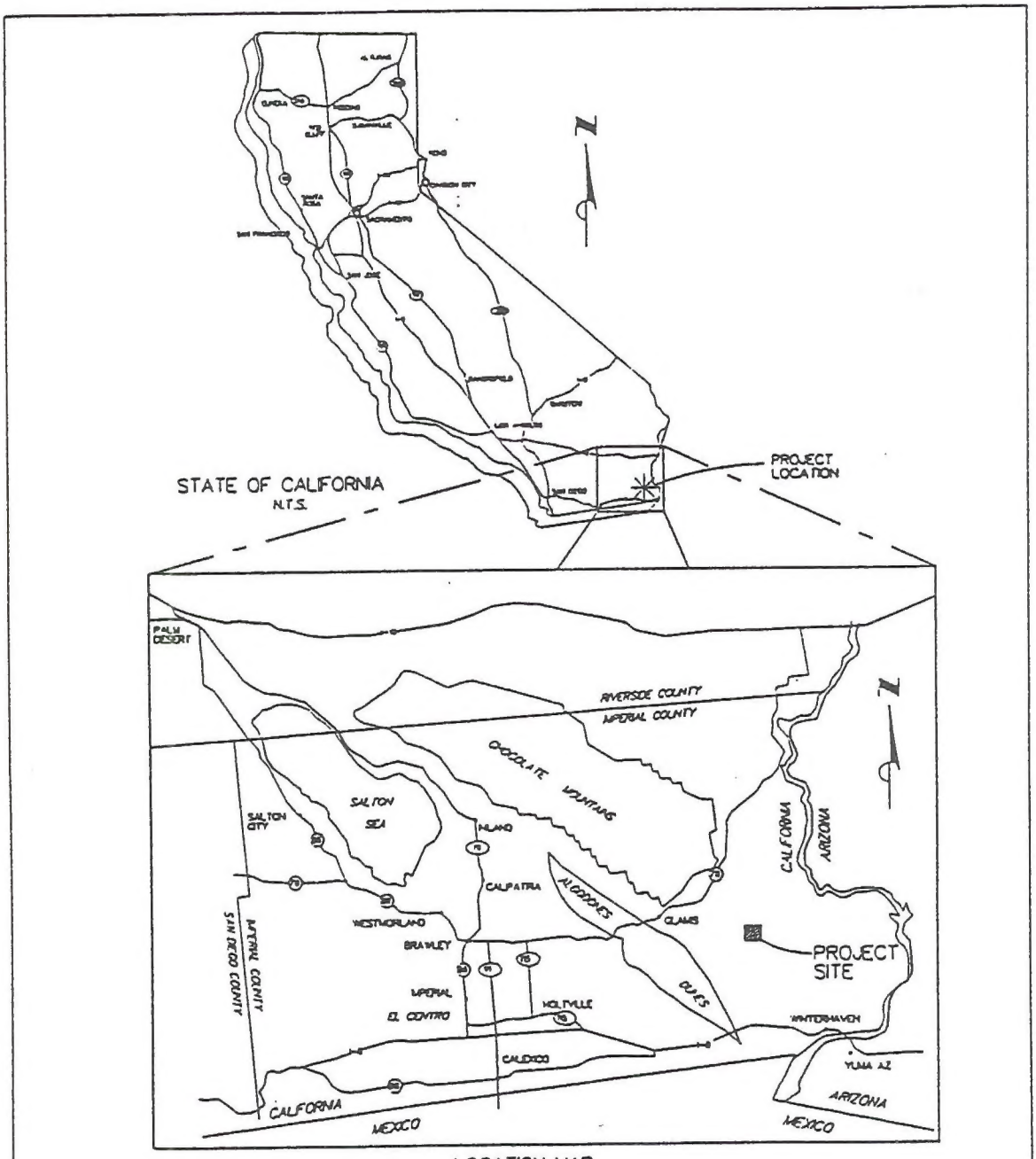
Responses must be received within 30 days following receipt of the NOP.

PROJECT DESCRIPTION: Chemgold, Inc. has proposed the development and operation of an open pit gold and silver mine and heap leach recovery operation known as the Imperial Project. The project site is located entirely on public lands administered by BLM. Approximately 120 tons of ore and up to 360 tons of waste rock would be mined from three open pits. Ultimately the three separate pits may develop into one large pit, mined in sequential phases. Up to 10 million tons of ore would be mined annually for a period of twenty (20) years. The ore would be processed at an on-site heap leach recovery facility. The proposed project would

include construction exploration activities, construction and maintenance of haul roads, realignment of Indian Pass Road, development of groundwater well and water lines, construction of an electric powerline, and reclamation of the mine site. Ore processing and final reclamation activities would be expected to continue for up to five (5) years after the completion of mining.

The project would encompass approximately 1,383 acres of new surface disturbance. Specific components of the project include: three (3) separate pits, with a possible expansion into a potentially mineralized areas consisting of 513 acres; four (4) waste rock stockpiles (379 acres); three (3) topsoil stockpile sites (65 acres); one (1) administration office and maintenance facility area (16 acres); one (1) heap leach facility (304 acres); one (1) precious metal recovery plant and other ancillary facilities (32 acres); one (1) ground water well designed to produce up to 1,000 gallons per minute (gpm) and yield approximately 1,000 acre feet per year; an electric substation and associated powerlines (29 acres); the relocation of approximately 10,000 feet of Indian Pass Road (7 acres); a drainage diversion system (9 acres); and, a system of haul roads within the project site which would connect the various facility components (29 acres).

JFS/CHEMGO11.REC



EMA ENVIRONMENTAL MANAGEMENT ASSOCIATES, INC. 100 WEST GROVE STREET, SUITE 100 RENO, NEVADA 89509	Scale : NO SCALE Dwg. No.: 0959-101 Drawn by: LT Date 11/9/94	IMPERIAL GOLD PROJECT PROJECT VICINITY MAP	FIGURE 1

Figure 1: General Project Location Map

DISTRIBUTION LIST

PROJECT: IMPERIAL GOLD EIS/EIR
APPLICANT: CHEMGOLD

YES	NO	
[X]	[ ]	BLM 1661 SOUTH FOURTH STREET EL CENTRO, CA 92243
[X]	[ ]	EHS 939 MAIN STREET EL CENTRO, CA 92243
[X]	[ ]	APCD 150 SOUTH NINTH STREET EL CENTRO, CA 92243
[X]	[ ]	DEPT. OF PUBLIC WORKS 155 SOUTH ELEVENTH STREET EL CENTRO, CA 92243
[ ]	[ ]	BUILDINGS & GROUNDS 1002 STATE STREET EL CENTRO, CA 92243
[ ]	[ ]	DEPT. OF PARKS & RECREATION 1002 STATE STREET EL CENTRO, CA 92243
[X]	[ ]	FISH & GAME COMMISSION 1002 STATE STREET EL CENTRO, CA 92243
[X]	[ ]	FIRE/OES 2514 LABRUCHERIE ROAD IMPERIAL, CA 92251
[ ]	[ ]	ASSESSOR 940 MAIN STREET EL CENTRO, CA 92243
[X]	[ ]	DEPT. FISH & GAME* 330 GOLDEN SHORES, SUITE 50 LONG BEACH, CA 90802
[X]	[ ]	IVC MUSEUM 442 MAIN STREET EL CENTRO, CA 92243
[X]	[ ]	STATE LANDS COMMISSION* 245 WEST BROADWAY, SUITE 425 LONG BEACH, CA 90802-4471
[ ]	[ ]	U. S. FISH & WILDLIFE SERVICE P. O. BOX 120 CALIPATRIA, CA 92233
[X]	[ ]	CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD* 73720 FRED WARING DR #100 PALM DESERT, CA 92260-2564
[X]	[ ]	DEPT. WATER RESOURCES* P. O. BOX 942836 SACRAMENTO, CA 94236-0001

[X]	[ ]	IID P. O. BOX 937 IMPERIAL, CA 92251
[ ]	[ ]	SOIL CONSERVATION SERVICE 444 SOUTH EIGHTH STREET EL CENTRO, CA 92243
[X]	[ ]	CALTRANS* DISTRICT 11 P. O. BOX 85406 SAN DIEGO, CA 92138-5406
[X]	[ ]	MINE RECLAMATION PROGRAM* MS 09-37 801 K STREET SACRAMENTO, CA 95814-3531
[ ]	[ ]	BUREAU OF MINES 360 THIRD AVENUE SPOKANE, WA 99202
[ ]	[ ]	STATE GEOLOGIST 1416 NINTH STREET, ROOM 1341 SACRAMENTO, CA 95814
[X]	[ ]	OFFICE OF MINE RECLAMATION* 801 K ST MS09-06 SACRAMENTO, CA 95814-3529
[ ]	[ ]	STATE MINING AND GEOLOGY BOARD 801 K STREET, MS 09-05 SACRAMENTO, CA 95814
[X]	[ ]	BUREAU OF RECLAMATION* LOWER COLORADO REGIONAL OFFICE P. O. BOX 61470 BOULDER CITY, NV 89006-1470
[X]	[ ]	DEPT. OF PARKS & RECREATION* 8885 RIO SAN DIEGO DRIVE, SUITE 270 SAN DIEGO, CA 92108
[X]	[ ]	BLM* YUMA DISTRICT OFFICE YUMA RESOURCE AREA 3150 WINSOR AVENUE YUMA, AZ 85365
[X]	[ ]	U.S. FISH & WILDLIFE SERVICE* ENHANCEMENT FIELD OFFICE MR. JACK FANCHER, SUPERVISOR 2730 LOKER AVENUE, WEST CARLSBAD, CA 92008
[X]	[ ]	EL CENTRO REGIONAL MEDICAL CENTER 1415 ROSS AVENUE EL CENTRO, CA 92243
[X]	[ ]	CAROL SASSIE DEPT. FISH & GAME P.O. BOX 1673 BRAWLEY, CA 92227
[ ]	[ ]	OCOTILLO CLUB P.O. BOX 51 OCOTILLO, CA 92259 ATTN: DAVID TUCKER

[ ]	[ ]	OCOTILLO COMMUNITY COUNCIL P.O. BOX 205 OCOTILLO, CA 92259 FAX #358-7918
[X]	[ ]	COACHELLA VALLEY WATER DISTRICT*
[ ]	[ ]	BUREAU OF RECLAMATION* YUMA PROJECTS OFFICE 7301 CALLE AGUA SALADA P.O. BOX D YUMA, AZ 85366 TEL 602/ 343-8261
[ ]	[ ]	SIERRA CLUB P.O. BOX 444 OCOTILLO, CA 92259 ATTN: EDITH HARMON
[X]	[ ]	MARINE CORPS AIR STATION-YUMA CP&L/MAO (3AQ/3AS) YUMA, AZ 85369-9114
[ ]	[ ]	BORDER PATROL AIR OPERATIONS 1111 N. IMPERIAL AVE. EL CENTRO, CAL 92243
[ ]	[ ]	SOUTHERN PACIFIC RAILROAD REAL ESTATE, 9TH FLOOR 1 MARKET PLAZA SAN FRANCISCO, CA 94104 415-541-1591
[X]	[ ]	STATE HISTORIC PRESERVATION OFFICER* 1416 NINTH STREET SACRAMENTO, CA 95814
[ ]	[ ]	FARM BUREAU
[ ]	[ ]	HEBER GEOTHERMAL COMPANY 895 PITZER ROAD HEBER, CA 92249
[ ]	[ ]	SECOND IMPERIAL GEOTHERMAL COMPANY 849 DOGWOOD HEBER, CA 92249
[ ]	[ ]	SCHOOL DISTRICT(S):
[ ]	[ ]	CITIES:
[X]	[ ]	COUNTY COUNSEL 940 MAIN ST. EL CENTRO, CA 92243
[X]	[ ]	NANCY ANDREW DEPT. FISH & GAME P.O. BOX 1347 BRAWLEY, CA 92227
[X]	[ ]	CHP 2331 HWY. 86 IMPERIAL, CA 92251
[X]	[ ]	OREN FOX, SHERIFF IMPERIAL COUNTY 328 APPLESTILL RD. EL CENTRO, CA 92243

[X]	[ ]	QUECHAN INDIAN TRIBE* FT. YUMA INDIAN RESERVATION P.O. BOX 11352 YUMA, AZ 85366-9352
[X]	[ ]	NATIVE AMERICAN HERITAGE COMMISSION*
[X]	[ ]	OFFICE OF PLANNING AND RESEARCH* OFFICE OF PERMIT ASSISTANCE 1400 TENTH ST. SACRAMENTO, CA 95814
[X]	[ ]	COLORADO RIVER BOARD*
[X]	[ ]	OTHER: YUMA COUNTY, STATE OF ARIZONA

JFS/DISTLIST.REC

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IX
75 Hawthorne Street
San Francisco, CA 94105-3901

April 5, 1995

Ben Koski, Area Manager
Bureau of Land Management
1661 S. Fourth Street
El Centro, CA 92243

Dear Mr. Koski:

The U.S. Environmental Protection Agency (EPA) has reviewed the Notice of Intent to prepare an environmental impact statement (EIS) for the **Imperial Project, Imperial County, California.** Our comments are provided pursuant to the National Environmental Policy Act (NEPA) and the Council on Environmental Quality's NEPA Implementation Regulations at 40 CFR 1500-1508.

The proposed Imperial Project is a gold mining/processing operation, which would include open pit mining, waste rock and heap leach facilities, a processing facility, and ancillary facilities. The project would operate for approximately twenty years.

The scope of subjects that should be included in the EIS is described in the enclosed comments. Topics include water resources, air quality, vegetation and wildlife, and mining waste and reclamation.

Please send us two copies of the Draft EIS at the same time it is officially filed in our Washington, D.C., office. If you have any questions, please call me at (415) 744-1584, or have your staff contact Jeanne Geselbracht at (415) 744-1576.

Sincerely,

David J. Farrel, Chief
Office of Federal Activities

Enclosure

cc: Robert Perdue, RWQCB-Colorado River Region
Imperial County Air Pollution Control District

Printed on Recycled Paper

General Comments

Information regarding the potential adverse impacts of open-pit mining and heap leaching and techniques for mitigating these effects has been collected over the last several years. Much uncertainty remains, however, regarding the long-term effects of land disturbance, mining wastes, acid rock drainage, groundwater withdrawals, and other effects of mining activities. The EIS should demonstrate that all reasonable alternatives to proposed actions have been examined and that appropriate mitigation measures have been thoroughly considered and incorporated into the project. The EIS should provide substantial detail on the means of implementing mitigation measures, and should also identify how monitoring would be set up to ensure compliance and assess effectiveness of mitigation.

Water Resources

1. For each alternative the EIS should discuss the project's compliance with state-adopted, EPA-approved water quality standards. The project planning should be fully coordinated with the California Regional Water Quality Control Board - Colorado River Region (RWQCB) to ensure that water quality is protected and beneficial uses are maintained.

2. The EIS should address the potential effects of all project discharges on surface water quality, such as thermal changes, increased suspended solids, toxicity, salinity, and pH, including cumulative impacts over time. The effects of such impacts on designated beneficial uses of the streams should be thoroughly considered.

In addition, the EIS should provide results of past/current water quality monitoring of any other mining operations that may exist in the project vicinity for groundwater and surface water over time. Any water quality trends should be discussed.

3. The EIS should note that, under the Clean Water Act, any project disturbing a land area greater than five acres requires a storm water discharge permit. The EIS should document the project's consistency with applicable storm water permitting requirements. Furthermore, a storm water pollution prevention plan should be included. The EIS should discuss specific mitigation measures that may be necessary.

4. The EIS should completely describe the original (natural) drainage patterns in the project area, as well as the drainage patterns of the area during project operations and following reclamation. Include hydrologic and topographic maps of the areas. This discussion should encompass effects of the project on erosion potential and sedimentation.

a. Identify whether any components of the proposed project would fall within 50 or 100 year flood plains. Discuss the potential for flash floods to transport sediment from disturbed areas to stream channels.

b. Describe the designs of the existing waste rock and heap leach facilities, seepage collection systems, and pumpback systems under the proposed project.

c. Discuss the potential for contamination of surface flows (perennial or from storm events) and rainfall which pass through waste rock dumps and heap leach and processing facilities. Describe mitigation measures to prevent this contamination, including the construction of run-on/run-off channels, impermeable covers, collection or sedimentation ponds, and any necessary treatment or disposal of these solutions.

d. Describe flow velocities of all discharges to surface waters and discuss whether these discharges could contribute to scouring and sedimentation in these channels.

5. Discuss how accidental releases of hazardous materials, including overflow from ponds would be handled. Identify the potential impacts resulting from failure of components of the solution containment systems and tailings ponds, methods for discovering such failures, and the degree to which impacts would be reversible.

6. The EIS should identify water sources for the project, and describe the potential impacts on groundwater and surface water, estimating rates of water use by the proposed project as well as all other related projects. Identify direct, indirect, and cumulative impacts to surface water flow, water supply wells, wetlands, springs and seeps, vegetation, wildlife, and other groundwater-dependent resources as a result of groundwater pumping associated with the proposed project. (See "Vegetation and Wildlife", page 6).

7. Discuss the acid generation/neutralization potential for waste rock and pit walls at the site. Describe the leach tests to be conducted on ore and waste rock and provide the results for each test. Describe the quality of waters at any mining sites nearby, particularly older mines, that may be used to predict future acid generation at the proposed project site. Describe and commit to measures to **prevent** acid generation and any mitigation measures that may be necessary should prevention measures fail.

8. Describe in detail the proposed facility design and operation, including liner and cover specifications, ditches and ponds, and maintenance and monitoring activities to ensure integrity of facilities throughout project operations and closure.

9. Describe the locations of all monitoring wells and points of compliance on the site. The screening intervals, parameters to be monitored, and monitoring frequencies should be discussed.

10. Provide projected chemical characterization of water in open ponds located at the site, including projected water quality in the open pits following closure. The potential for and effects of movement of any contaminated surface water to the subsurface should also be discussed.

11. We recommend that the EIS describe the chemistry of cyanide in water and soil, and the cyanide budget resulting from leach processing at similar mines. Estimate quantities of cyanide likely to be "lost" and its fate.

12. Consult with the U.S. Army Corps of Engineers to determine if the proposed project requires a Section 404 permit under the Clean Water Act. Section 404 Regulates the discharge of dredge or fill material into waters of the United States, including wetlands and other "special aquatic sites."

If a permit is required, EPA will review the project for compliance with Federal Guidelines for Specification of Disposal Sites for Dredged or Fill Materials (40 CFR 230), promulgated pursuant to Section 404(b)(1) of the clean Water Act.

If dredged or fill material would be discharged into waters of the U.S., the EIS should discuss measures that would be taken to mitigate impacts. This discussion should include: (a) acreage and habitat type of waters of the U.S. that would be created or restored; (b) water sources to maintain the mitigation area; (c) the revegetation plans including the numbers and age of each species to be planted; (d) maintenance and monitoring plans, including performance standards to determine mitigation success; (e) the size and location of mitigation zones; (f) the parties that would be ultimately responsible for the plan's success; (g) success criteria; and (h) contingency plans that would be enacted if the original plan fails. Mitigation should be implemented in advance of the impacts, to avoid habitat losses due to the "down time" experienced until an area is successfully revegetated.

Air Quality

1. Discuss the National Ambient Air Quality Standards (NAAQS) and Prevention of Significant Deterioration (PSD) increments applicable to air quality in the project area. The EIS should discuss the attainment status of the project vicinity for priority pollutants. PSD increments exist for sulfur dioxide, total suspended particulates, and oxides of nitrogen. Discuss impacts to the NAAQS and PSD increments from estimated emissions, considering the cumulative effects from all aspects of mine excavation, construction, operation, and support activities, such as vehicle traffic. The Bureau of Land Management (BLM)

should closely coordinate with the Imperial County Air Pollution Control District regarding regulatory requirements and controls. The EIS should also discuss whether a PSD permit will be required for the project. Discuss any mitigation measures necessary to comply with NAAQS and PSD.

2. PSD increments are highly protective of air quality in Class I areas such as wildernesses and national parks. The PSD increments for total suspended particulates are 5 ug/m^3 (annual) and 10 ug/m^3 (24-hour). The PSD increments for sulfur dioxide are 2 ug/m^3, 5 ug/m^3, and 25 ug/m^3 (annual, 24-hour, and 3-hour respectively). The EIS should identify any Class I PSD areas located within at least 100 kilometers of the proposed project site. Class I areas even further away could potentially be affected as well. The BLM should consult with the U.S. Forest Service and the National Park Service for a determination of which areas could be adversely affected by the proposed action. Potential impacts to Class I PSD areas, including visibility impacts, should be discussed.

3. Discuss the applicability and requirements of the New Source Performance Standards for Metallic Mineral Processing Plants (40 CFR Part 60.380-386) with respect to the proposed project.

4. Pursuant to the requirements of §176(c) of the Clean Air Act, 42 U.S.C. §7506(c), Federal agencies are prohibited from engaging in or supporting in any way an action or activity that does not conform to an applicable State implementation plan. Conformity to an implementation plan means conformity to an implementation plan's purpose of eliminating or reducing the severity and number of violations of the national ambient air quality standards and achieving expeditious attainment of such standards. EPA has promulgated regulations at 58 Federal Register 63214 (November 30, 1993) implementing §176(c). Among other things, these regulations establish de minimis levels for actions requiring conformity determination, exempt certain actions from conformity determinations, and create criteria and procedures that Federal agencies must follow for actions required to have conformity determinations. You should review these regulations and discuss their applicability in the EIS. If you have any questions on these or other conformity requirements please contact Bob Pallarino in our Air and Toxics Division at (415) 744-1212.

5. The EIS should discuss the possibility of an air quality monitoring program which would be implemented to ensure project compliance with all applicable air quality standards and permits.

Vegetation and Wildlife

1. The BLM should work closely with the U.S. Fish and Wildlife Service and the California Department of Fish and Game

to determine potential impacts of the project on plant and wildlife species, especially species classified rare, threatened, or endangered on either state or federal lists. We also request that you provide information on potential impacts to candidate species.

2. Poisoning of animals attracted to pregnant solution ponds has been a serious problem with heap leach operations. Discuss the mitigation measures which would be taken to prevent exposure of migratory waterfowl and other wildlife to any toxic waters used in or resulting from processing the ore. Identify how solution impoundments would be treated to prevent poisonings. Netting and scare tactics are not completely reliable prevention measures. We recommend that serious consideration be given to covering all pregnant solution ponds on the project site.

3. In addition to jurisdictional waters of the U.S., including wetlands, discussed above on page 4, the EIS should identify wetland and riparian habitat as well as other unique or important habitat areas that could be affected by the project. The EIS should discuss avoidance, minimization, and mitigation of losses or modification of habitat and plant and animal species composition. We recommend that the EIS include a detailed mitigation plan, such as that recommended on page 4, for replacement of habitat adversely affected by the proposed project.

Mining Waste Management and Land Reclamation

1. The EIS should discuss any measures to be taken at the proposed project site to ensure compliance with applicable Resource Conservation and Recovery Act regulations.

2. The EIS should discuss the following components of waste management and reclamation plans: (a) a detailed account of measures taken to decommission mine operations, stabilize slopes, and neutralize or cap waste rock and leach heaps; (b) identification (including estimated acreage) of the areas targeted for reclamation, and clarification of the intended degree of treatment in each area; (c) estimation of any irrigation requirements; (d) timing of reclamation relative to mining operations and duration of reclamation treatment; (e) standards for determining and means of assuring successful reclamation; and (f) means of assuring that any maintenance required for reclaimed areas would continue after operations cease or while operations are suspended.

3. We recommend that the reclamation plan be coordinated with a site-specific closure plan. Further, EPA recommends that the EIS evaluate in detail ways to implement reclamation concurrently with operations. We believe that, rather than deferring reclamation until mine closure, reclamation during operations can be beneficial both environmentally and financially.

4. We recommend that BLM require that revegetation be accomplished with only native species indigenous to the area in order to restore the ecosystem to as natural a state as possible after mine closure. We also recommend that revegetation success be monitored and enforced for at least five years following revegetation efforts. First or second year success in meeting the revegetation standards is not necessarily indicative of long-term success.

5. We recommend that the EIS discuss provisions that would be made for post-operation surveillance to ensure that neutralization and/or stabilization of mining waste sites has been effective. Describe the mitigation actions that would be taken should destabilization or contamination be detected and identify who would be responsible for these actions.

6. The EIS should specify the bonding requirements to ensure that appropriate funding is available for reclamation should the mining company fail to carry out all required reclamation activities. Also identify who would be responsible for any post-closure cleanup actions should they be necessary.

Land Use

If the project area is currently grazed, the EIS should discuss impacts to livestock grazing in the project vicinity and whether reduction in forage would necessitate a reduction in livestock grazing in the area for the duration of the project in order to prevent overgrazing. Identify any other special uses that would be displaced by the proposed project and discuss the proposed project's specific potential impacts to these uses.

Environmental Justice

In keeping with Executive Order 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations" (EO 12898), the EIS should describe the measures taken by the BLM to: 1) fully analyze the environmental effects of the proposed federal action on minority communities and low-inclome populations, and 2) present opportunities for affected communities to provide input into the NEPA process. The EIS should state whether the analysis meets requirements of your agency's environmental justice strategy.

Cumulative Impacts

The EIS should address potential cumulative impacts to resources, considering the proposed project in the context of past, current, and reasonably foreseeable future mining and other activities in the project vicinity. The analysis should include a discussion of impacts to water and air quality, hydrology, soils, vegetation, wildlife, and biodiversity.

FILE COPY

Yuma County, Arizona
DEVELOPMENT SERVICES DEPARTMENT
2703 S. Avenue B • Yuma, Arizona 85364

April 14, 1995

RECEIVED
APR 18 1995
IMPERIAL COUNTY
BUILDING INSPECTION

Mr. Jesse Soriano
Imperial County Planning/Building Department
939 Main Street
El Centro, CA 92243

Dear Mr. Soriano:

Thank you for providing our office with an opportunity to review the Notice of Preparation of a Draft Environmental Impact Report for the Imperial Project (Eastern Imperial/Indian Pass Road) area.

Many citizens of Yuma County enjoy a wide range of outdoor recreational oportunities in southeastern California. Public lands at or near the border of our two states are popular destinations for both active and passive outdoor recreation for Yuma and Imperial County citizens. The proposal you have referred to us does not appear to negatively impact Yuma County or its citizens.

Please let me know if you have any questions.

Sincerely,

John F. Merrell

John F. Merrell
Planning Director

JFM/am
95-139

Post-it® Fax Note 7671	Date 4/29/95	# of pages ▶ 4
To Eric Mintz	From Jesse Soriano	
Co./Dept.	Co.	
Phone #	Phone #	
Fax # 714-529-8543	Fax #	

RECEIVED FROM 6193538338 01-29-1995 08:51 P.1

DATE April 20, 1995

PLANNING / BUILDING DEPARTMENT
COUNTY OF IMPERIAL
(619) - 339 - 4236

MEMORANDUM

TO Imperial Project File - Chemgold

FROM Jesse Soriano, Planner III

SUBJECT Palo Verde Irrigation District

On April 17th, a person named Roger Henning of PVID called and left a message. He said they had received the NOP and that PVID has no comments since the project site is located outside the district boundary. Telephone No. 922-3144.

JFS/DOC.

PROJECT TYPE

FILE NO.

LASER, INC.

LEGAL AND SAFETY EMPLOYER RESEARCH

AN INDEPENDENT, INCORPORATED DIVISION OF THE WESTERN STATES PIPE TRADES

670 Kentucky Street, Gridley, CA 95948 (P) 916/846-6352 (F) 916/846-5274

APRIL 17, 1995
TO BLM BY FAX
ATTN: MR. ZALE
SCOPING COMMENTS ON THE CHEMGOLD/GLAMIS MINE DEIS AND POO

Dear. Mr. Zale:

Legal and Safety Employer Research (LASER) is a non-profit group that reviews large industrial projects in the Western United States. Here are LASER's scoping comments on the Chemgold/Glamis proposed mine.

Please send copies of all scoping comments received by your agency, and future materials such as the DEIS on this project, to LASER's consultant;

John Williams
12770 SW Foothill Dr.
Portland, Ore 97225
(503) 626-5736, fax-503-641-2093

Thank you for your past and future cooperation.

Yours,

Jim Wilson

cc: John williams
attorney David Rosenfeld

04-17-95 11:34AM [58] P1

PROCEDURE

A "Master" EIS may be appropriate. This EIS would consider the cumulative impacts of past and anticipated mine expansions and minerals exploration projects within this and neighboring BLM districts and National Forests. The EIS would gather baseline data on the current environment in these jurisdictions and around this site. It would include evaluations of the existing air and water quality, summaries of typical impacts from mining, and inventories of wildlife and plant life.

After this comprehensive review, future proposals for minerals exploration and mining could be handled by incorporating by reference the "Master" EIS' findings into individual EISes that would be completed for future minerals exploration and mining projects.

A sweeping examination of the cumulative impacts from minerals exploration and mining would benefit the review process. It is difficult to evaluate the probable total impacts of exploration projects, mines, and mine expansions when considering these proposals one by one. But without weighing the probable total impacts, one cannot recommend appropriate mitigations. The cumulative impacts of these projects can be considerable. These cumulative impacts should be evaluated in a single comprehensive document.

Alternatively, LASER strongly supports the inclusion of the Glamis's project impacts in the supplemental EIS under preparation that is considering the Barrick Mine's and other mines' cumulative impacts on ground water in the Humboldt River Basin. Likewise, the descriptions of mining's cumulative impacts, as described in that supplemental EIS should be incorporated/referenced in the separate DEIS specifically for the Glamis project.

For instance, the groundwater withdrawal impacts from the Fortitude mine, which is near the Glamis project, have been shown to be part of an area-wide cumulative groundwater impact (Tom Myers report to the Sierra Club, 3/10/94). These cumulative impacts should be discussed in the Glamis DEIS, along with this proposal's prospective contribution to these problems.

PROJECT AND AREA DESCRIPTION

Please include a land ownership map for the surrounding area, and a preliminary site plan, including the anticipated location of all major structures, roads, parking areas, on-site temporary housing, staging areas, construction material sources, and toxic and hazardous material handling and storage areas.

Please provide a general description of the major components of the facility, including boilers, leach pads, steam generators, turbine generators, power lines, transformers, roasters, autoclaves, cooling facilities, SW/EX facility, production equipment, pits, haul roads, tailings piles, stream diversions, stormwater, process water, barren solution and pregnant solution ponds, and heaters.

Please describe the amounts of material that flow into the project (for instance water, ore, natural gas, caustic, hydrocarbon, electricity) and product and byproduct that flow out of the project. (ore concentrate, tailings, waste water, solid waste)

Please list all permits needed by the project. Please estimate the existing and projected noise levels at the project site.

Please describe the project area's land use patterns at and near the site location, including descriptions of any state or local land use plans.

Describe the procedures proposed to avoid constituting a public nuisance, endangering public health and safety, human and animal life, property, wildlife and plant life, or recreational facilities, including a description of monitoring programs to assess the impacts of the proposed mine and the effectiveness of those controls to mitigate environmental, social and economic impacts of the proposed mine.

SIGNIFICANT IMPACTS THAT SHOULD BE DISCUSSED IN A REVIEW OF THE PROPOSED PROJECT

LASER is concerned about the proposed mine expansion's potential impacts on the air and water quality. There could be adverse socio-economic consequences caused by the importation of an out of state construction and production work force.

LASER's comments apply to the commonly employed hiring practices and construction techniques of many engineering firms and out of state low-wage construction contractors in the mining industry.

What follows is a list of details and information that should be included in the EIS for this project.

AIR QUALITY

The EIS should discuss the cumulative air quality impacts from the existing facility, the proposed project, and the existing emissions from the nearby mines, mills, smelters, and exploration projects. The total effect of this area's air pollution on the health of humans and wildlife and plant life needs evaluation.

The EIS should describe whether or not the area near the proposed mine is in compliance with state and federal standards for criteria and non-criteria pollutants.

The EIS should include a table showing any measurements of current and recent concentrations of air pollutants in and near the proposed site, including nearby mines, both on and off site. These measurements should include any sampling by the state and federal environmental agencies, or by inspectors from the state and federal Occupational Safety and Health Administration, the federal Mine Safety and Health Administration (MSHA).

04-17-95 11:35AM [58] #3

PARTICULATE EMISSIONS

The proposed project will emit particulate matter (PM) from the non-point sources of traffic on unpaved roads, erosion from slag piles and stockpiles, and dust from drilling and explosives. Point sources of PM include silos, crushers, screening, truck and leach pad loading and unloading, the SW/EX facility, generators during construction and operation, and the conveyors and elevators.

IMPACT FROM CONSTRUCTION AND ROAD BUILDING

The mine construction will cause discharges to the air of PM, oxides of nitrogen (NOx), carbon monoxide (CO), hydrocarbons (HC), and sulfur dioxide (Sox) from windblown and vehicle generated road dust, blasting, vehicle and equipment engines and generators, drilling equipment, and gravel crushing for road building.

The construction and improvement of roads will require thousands of hours of operation of heavy equipment and power tools, including bulldozers, backhoes, graders, chainsaws, and cranes. This equipment will generate additional air pollutants. Surfacing the new and improved roads may necessitate rock crushing operations, which will generate PM from the crushing, and other air pollution from the equipment engines.

The engines and compressors that power the roadbuilding and construction equipment should be described, the quantities of each type of engine should be listed, the total hours of operation for these engines should be figured, and the resulting pollution tonnage and concentrations of PM, HC, Nox, CO, and Sox from those diesel and gasoline fumes should be calculated.

The emissions from these sources can be calculated with criteria developed by the Federal Environmental Protection Agency's "AP-42" methods. Alternative low-pollution fuels for vehicle and equipment engines, and dust control measures such as haul road paving should be discussed.

DIESEL STORAGE AND USE

The EIS should say how much diesel fuel will be consumed by the mine equipment and vehicles monthly and annually, how much diesel is stored on site, how often there are deliveries, and the HC emission rate from the storage tanks, from refueling of vehicles and equipment, and from vehicle and equipment exhaust. Since nickel is emitted in diesel (and gasoline and fuel oil) exhaust, the amount of nickel emissions and other toxics such as chromium, benzene, benzo a pyrene, and polyaromatic hydrocarbons should also be estimated from diesel use and other sources.

EMISSIONS INVENTORY

The proposed project may have several point sources of lead and other metals, CO, Nox, ammonia and other toxics, acid, HC, PM and Sox. These potential sources may include crushers, conveyors, silos, elevators, natural gas, oil or coal-fired heaters and boilers, acid drift from the leach

TO: ERIC MINTZ 619 - ... FROM: Keith Shone

pad acid handling processes, storage tanks, oxidation processes, solvent extraction and electrowinning (SX-EW) circuit processes, storage, loading and unloading, and regeneration of materials including but not limited to solvents, carbon, acids, and drift from leach pad sprayers.

The project's expected emissions in lb/hr. and ton/yr. from both point and non-point sources, and the average and maximum concentrations of these pollutants at different distances from the project should be described. This should include but not be limited to concentrations of air pollutants near the mine site and at the nearest Class I air shed.

An emissions and air pollution source inventory for the nearby mines and other air pollution sources, including but not limited to mineral exploration projects should be provided. Criteria, non-criteria and toxic pollutants should be listed.

TOXIC AIR EMISSIONS

Mine Safety and Health Administration (MSHA) records show that many metal mine and mill workers become ill from exposure to high levels of lead, cyanide, chlorine, ammonia, and sulfur dioxide.

Several incidents at gold mines may also be relevant. MSHA records on mine workers at Newmont and IMC in Nevada, and the Stibnite/West End mine in Idaho show they suffered injury from exposure to chlorine, for instance. Worker injury from cyanide exposure and inhalation is illustrated below. Alternatives to cyanide, such as thiourea should be discussed.

PROTECTION FOR WORKERS AND THE ENVIRONMENT FROM LEACH PAD FUMES

The leach circuit processes should be tanked instead of using heap leach pads. Mine Safety records show that many mine and construction employees are injured by cyanide exposure at cyanide leach ponds.

The Arizona Mine Inspector cyanide procedures guidelines state flatly that heap leaching emits cyanide, for instance.[1] If cyanide fumes are migrating from leach pad areas, that may cause worker injury. Workers will also be exposed to cyanide dust during the loading and unloading of cyanide at storage silos.

MSHA records show workers injured by ingesting cyanide at the following gold mines: Round Mountain, Northcumberland, Nerco Candelaria, Barrick, and Homestead in Nevada, and Nerco Ironclad and Druid in Colorado.

Examples of cyanide-induced illnesses are cited below.

Round Mountain mine, Nevada:
"Employee working near leach pad on windy day. Possible reaction to

---

[1] Office of State Mine Inspector, Cyanide Health and Safety Procedures. pp. 8 and 25. 1991.

IN [13] 08:21AM 05-02-95

sodium cyanide coming from sprayers in leach pad area." (MSHA, 3/16/89, mine 26-0594)

Nerco Ironclad, Colorado

"The men were exposed to hydrogen cyanide gas and they were exposed to sodium cyanide solution ... the sodium cyanide solution was not monitored and did present a life threatening condition." (MSHA, 7/9/85, mine #05-3695)

This data shows that any materials used at mines and in the leach circuit may be emitted and inhaled by workers.

MSHA records show that some of the Annie Creek, South Dakota mine workers have elevated lead levels in their blood. Lead could be a pollutant emitted by Glamis if it is located in the ore or overburden, or if it is used in the components of the SW/EX process, for instance the alloy anodes.

The DEIS should evaluate OSHA 200 logs and MSHA 7000-1 forms that report accidents, injuries and illnesses at mines with processes similar to the Glamis proposal to determine what health hazards may be present. This would also assist estimates of the mine's impacts on local health services.

Emissions of these substances from the Glamis facility should be evaluated. The potential for the Glamis/Chemgold proposal to emit lead, mercury, silica, cyanide, diatomaceous earth dust, chlorine, arsenic, ammonia, hydrochloric acid, diesel fumes, and other metals and toxics should be considered. Depending on the configuration of the facility, cobalt, arsenic, bismuth, and selenium may be emitted. If it is forecasted that Glamis/Chemgold will emit these or other toxic materials, then the health effects of these substances on its workers, and on nearby populations, should be described.

If toxic materials will be emitted by Glamis/Chemgold, and these materials could cause or contribute to elevated levels of respiratory diseases, cancers, or other ailments, than these illnesses should be listed and described.

The DEIS should include information from local and national cancer registries and state and federal logs of occurrences of respiratory diseases and cancers, showing the current incidence rates for these illnesses in nearby Counties.

BACT/LAER SHOULD BE REQUIRED

Air pollution controls for the proposed expansion should be described. Best Available Control Technology (BACT) and Lowest Achievable Emission Rate (LAER) for the potential point sources should be discussed.

Other potential controls should include but not be limited to road watering or paving, drilling and explosive dust controls, enclosure of leaching, solvent and electrowinning extraction processes, scrubbers, and alternative low pollution vehicle and engine fuels such as methanol and

propane.

Air permits for similar facilities, and the Glamis/Chemgold air permit application, should be appended to the DEIS, to provide an overview of emissions and controls that could be expected.

PREVENTION OF SIGNIFICANT DETERIORATION (PSD) REVIEW

If the project will emit more than 250 ton/year of any single air pollutant, then it is required to undergo a PSD review by the EPA or its delegate. The DEIS and the air permit applications should be sent to the EPA, Region 9 to determine if a PSD review is required.

WATER QUALITY

The surface water and groundwater in the vicinity of the proposed pits should be described fully. The DEIS should contain a site map and a cross-section that compares the proposed mine activity with the aquifers and surface water bodies, and their recharge and discharge areas. Probable effects on groundwater and surface water should be discussed, including cumulative impacts with other mines in the Humboldt groundwater basin.

The impact of prior mining activities on the area's water should be described. The water quality downstream of the mine site, along with the uses of these water bodies, should be discussed.

WATER USE

Where does mine process water come from, and how will waste water be discharged, and in what amounts, and containing what contaminants? The impact of the ground water drawdown from mine dewatering and well water usage on the area's surface water and well water supply should be detailed. The cumulative effect of the other mines in the area and their dewatering should be considered.

The mine's drawdown of groundwater should be discussed regarding its effect on other water users. A description of the area's groundwater rights and the current holders of these rights, including the location and use of nearby wells, the amounts to which they are entitled, the depths of their wells, and the current drawdown rate should be described.

Amounts of water pumped, discharged, and consumed by proposed and other nearby current and future projects should be estimated and the cumulative effects described. How will additional blasting and drilling affect groundwater?

GROUNDWATER

The DEIS should characterize and identify each aquifer/water bearing zone that may be effected by the mining operation. Enough information should be provided to determine the flow rate and direction of groundwater movement in each aquifer/water bearing zone in the vertical and horizonal zones, as well as the ground water quality.

04-17-95 11:36AM [58] P6

The area's aquifers should be characterized by type; unconfined, confined, leaky, perched, geothermal, etc.

If geothermal features or hot springs are in the area, then drilling or the digging of mine pits may drain or vent these sources. This possibility should be examined.

The following data should be provided:

The potentiometric surface of each aquifer based on simultaneously measured water level data.

The hydraulic conductivity of each aquifer, the regional and local groundwater flow pattern, flow velocities/rate and direction, temperature, the regional and shallow groundwater quality, local and regional flow boundaries for each aquifer, and the storage coefficient for each aquifer.

The porosity measurements for each aquifer, (important for groundwater flow velocity calculations), the vertical hydraulic gradient within each aquifer, a fracture description and orientation to assess boundaries or conduits.

Aquifer testing is suggested to determine flow boundaries, storage coefficient, and transmissivity/hydraulic conductivity.

Geophysical logging is suggested to confirm lithology and saturated zone locations.

What lithologic units are saturated? What lithologic units act as confining layers? What units serve as aquifers? What is the chemistry of each aquifer and how does it vary spatially? Where and how do the aquifers recharge and discharge?

Data from nearby wells should be presented, including the lithology, type of material, depth to top and bottom of each lithologic section, the depth to the top and bottom of each water-bearing zone, the water quality, temperature and flow rate from each zone, and the static water level associated with each zone.

Samples from wells that extend beyond the bottom of the proposed bottom of the mine pits are needed, to adequately characterize the deeper aquifers that may be affected by the mine.

When the mine is closed, the pits may fill with water that is highly acid and lacking oxygen. This possibility should be examined. The alternative of backfilling the pits should be explored.

STORM WATER AND PROCESS POND AND PIT CAPACITY

The process water ponds, ditches, and leach pad should be lined with two synthetic liners and compacted clay, and underlain with a leak

collection system. These containment structures and the surface water diversion channels should be bermed and sized to contain runoff from a 24 hr., 1000-yr. storm event. The dimensions of recent flows in nearby steams and other surface water bodies should be described, including flash floods.

At least two synthetic liners, a 3 foot thick compacted clay or cement or asphalt liner, and a leachate collection system should be required under the leach circuit, process ponds, and drainage facilities.

LEACH TREATMENT ALTERNATIVES

Treatment of cyanide solutions with ferrous sulfate or other materials should be evaluated. Cyanide concentrations and Ph levels in the ponds and pads should be monitored continuously.

The EIS should require a study on the relationships between concentrations of free cyanide and WAD cyanide in process solutions.

LEAK DETECTION SYSTEM

The most important component of this proposal is the leak detection system. The type and dimension of pipe used should be described. Some sort of fabric protection must be provided for these the leak detection collection pipes, or fines may clog the pipe perforations and render the pipe inoperative. This same criteria should also be provided for the pregnant ponds and storm water ponds.

POSSIBLE EFFECTS ON WILDLIFE, THREATENED AND ENDANGERED SPECIES, AND THEIR HABITAT

Describe the project area's species, their populations, available habitat, their migration routes, and the summer and winter ranges of wildlife in and near the project area, particularly species that are listed or proposed for listing as endangered or threatened, or are species of state or Federal concern.

Changes in surface water distribution can affect fish and wildlife abundance and distribution. Since the project is located in an arid environment, all existing water sources have wildlife dependent upon its current location. Any disruptions by the project to surface springs, groundwater, and surface water bodies should be clearly documented and mitigated. For instance, the construction of the tailings facility will involve diversion of surface water.

WILDLIFE HARMS FROM THE LEACH PAD AND PROCESS PONDS

The DEIS should contain measures protective of wildlife regarding the leaching processes, process ponds, and tailings ponds, including but not limited to several alternatives; 1" netting, floating pond covers, 8' tall wildlife fencing surrounds the pads and ponds, or enclosure of these processes within tanks. Hazing may be suggested as an alternative to prevent water fowl from entering contaminated ponds. But hazing is ineffective against fowl for two reasons: birds quickly learn that it is not

04-17-95 11:37AM [58] #8

a threat, and exhausted fowl will not pay attention to hazing.

The DEIS should discuss requiring training of mine personnel in methods of reviving poisoned birds and animals.

If the mine does use open leach pads, pregnant ponds and storm water and process ponds, then treatment of the solutions in the ponds should take place to reduce the concentrations of toxic materials to levels that will avoid adverse effects on fish and wildlife. Cyanide concentrations as low as .005 mg/l have been shown to adversely certain species. Concentrations of toxic materials and Ph levels in the ponds and pads should be monitored continuously.

The DEIS/Plan of Operation should prohibit spraying of leach solution onto the heap leach pad and instead mandate a drip system. This would greatly reduce the emissions and drift that comes from the sprayers, and also reduce the ponding of solution on the heaps that can attract wildlife and fowl.

INCREASED SILTING

This project will increase erosion. The silt in this erosion will adversely affect surface water bodies and could harm the habitat of fish and wildlife.

The proportion of fine sediment less than .25" in diameter in the erosion caused by the mine should be estimated and the impact of these fines on fish spawning grounds should be described. The cumulative effect of sediment from other mines and other sediment sources on fish habitat and spawning grounds should be discussed.

BLASTING

Blasting may drive away many animals. During blasting at a hydroelectric project on the Pit River in Northern California, the antelope population abandoned the area, even after blasting ceased. (California Fish & Game, comments to BLM and BLM submitted regarding the Hayden Hill gold mine, 1991)

SOILS

What are the soils and rock types of the proposed area, how are they distributed, what are their thicknesses, what are their hydraulic and chemical properties, including but not limited to acidity and alkalinity? What is the surface and subsurface geology of the proposed area?

Please describe nearby lithologic formations and their thicknesses. What and where are the area's geologic structures? How many acres of what types of soils will be degraded by the project? Will Glamis/Chemgold be able to stockpile sufficient topsoil for reclamation of the site? It is likely that any topsoil stockpiles will degrade during the years of storage and may comingle with poor quality soils. In this event, how will Glamis/Chemgold reclaim this site.

04-17-95 11:38AM [58] #9

TOXICS

Please list the types of toxic materials used or handled at the proposed facility, including but not limited to acids, caustics, hydrocarbons, ammonia, cyanide, chlorine, zinc, antimony, lead, and cobalt. The amounts of toxics stored on site, the method and frequency of transport for these materials to and from the proposed facility, the amounts of toxics to be emitted into the air and water, the type of pollution controls and storage facilities for the toxic materials, and spill control measures should be discussed.

The project may operate heap leaching and solution ponds. The alternative of containing toxic mine processes within storage tanks, including but not limited to the heap leaching process and the pregnant and barren ponds, and tailings ponds, should be presented.

Any netting, fencing or other methods to reduce wildlife exposure to cyanide and other toxics at the project's leach pads and toxic pits should be described. These methods should be compared in efficiency and costs to the alternative of tanking these toxic fluids and processes.

THE AGENCY SHOULD NOT REJECT THESE PROJECT ALTERNATIVES BECAUSE OF THE DEVELOPER'S ECONOMIC JUSTIFICATION

The alternative of containing toxic mine processes within storage tanks, including but not limited to the heap leaching process, should be discussed. But before the agency accepts the mine's claims that this alternative should be rejected because of its expense, it should require the calculation of the clean-up costs of reclaiming the conventional heap leach pits. This cost should be compared with the costs of remediating a tank farm that could provide an alternative leaching method.

In addition, the open cyanide process, in contrast with an contained, enclosed system, would increase the chance of spilling and leaking cyanide solution. Storm water would not enter a closed cyanide system as readily, reducing the possibility that the system would flood and release cyanide tainted solution. The possibility of leaks from open processes, and the costs of clean-up, should be compared with the probability of leaks from enclosed processes, and those clean up costs.

For instance, the Ivanhoe mine and the Bond mine in Beatty, Nevada, and Nevada Gold and Viceroy Gold's Castle Mountain mine in California contain their pregnant and barren solutions within wholly enclosed tanks. The Ivanhoe procedure of enclosing its processes in two tanks of 120,000 gallons each is environmentally superior to the Glamis/Chemgold leach pad proposal. Ivanhoe's practices also demonstrate that tanking of these solutions is economically feasible.

CONTAMINATION

How will the migration and geochemical reaction of water moving through the open mine, the pits and the tailings piles be calculated? How many aquifers will be modeled? How many dimensions will be considered?

04-17-95 11:38AM [58] #10

What boundary conditions will be used? What will be the water chemistry after percolating through the tailings pile, and what is the chemical fate of this leachate if it enters the subsurface and groundwater, springs, and wetlands?

What will happen if the heap leach and/or tailings liner, pregnant pond liner, or ditches, or other containers of chemicals or solvents fails/leaks? What will be the leakage rate, the concentration of the solution constituent at the point of leakage and the facility boundary? Where would the leachate solution go? What type of leak detection system will be employed? What are the proposed long term monitoring plans for the facility?

UPSET CONDITIONS

The proposed mine will handle large amounts of toxic and hazardous materials. Any severe upset condition could release large amounts of these dangerous agents. An circuit failure or upset could mean that pumps may fail, warning systems would not sound, and toxic releases could begin unnoticed and unabated. For instance, a chemical fire and explosion at the Parish Chemical company in Orem, Utah occurred in July, 1992 because of a power outage. (Associated Press, 7/26/92) Such upset conditions deserve serious evaluation in the DEIS.

CLEAN-UP

How will the mine provide funds for cleanup/monitoring/reclamation, following mine closure? How will waste, heap leach and tailings piles, ponds and ditches be constructed to prevent leakage, discharge to land surface or drainages, and to detect leakage and discharges? Will the mine have enough topsoil stockpiled for the reclamation?

The DEIS should describe the mining and industrial compliance record of Glamis/Chemgold and its parent companies including but not limited to the operation of its subsidiaries and the mines and companies in which it is a partner or major stockholder. This narrative should list all toxic releases by its subsidiaries, or by companies and mines in which it is a partner or large stockholder, and any violations of rules regarding air and water pollution, toxic clean-ups, health and safety violations, and related litigation involving this mine operator.

The DEIS should contain safeguards to insure that the mine promptly clean-ups and reclaims its mine site. How will the mining activity affect future and current land uses, including but not limited to tourism, agriculture, timber harvest, geothermal energy, and recreation? What is the lost revenue from these activities that are curtailed by the mining project? How will the recent memo by BLM in California regarding backfill of mining pits affect the obligations to backfill at the Glamis site?

BONDING

The DEIS should discuss the appropriate size of a bond to finance reclamation of the mine site, such bond to be posted by the mine developer.

04-17-95 11:39AM [58] #11

This sum should be at least $6000 per acre of disturbed area.

Please include a statement of the applicant's financial condition, including a profit/loss statement, debt to equity ratio and summaries of annual reports for three years. This information is needed to evaluate the bonding requirements.

ORE AND WASTE ROCK ANALYSIS

The DEIS should contain information from meteoric water mobility tests on ore and waste rock from the mine site that is representative of each existing and each proposed source of ore. If there are geologic boundaries that geochemically define one region of an ore body from another region within the same body, a meteoric water mobility test must be performed for each region. If a ore body is geochemically homogenous than the mine owner should provide a statement of such.

ENERGY USE AND TRANSMISSION LINE

Please discuss the project's energy demand, type and size of transmission line needed, the route of the new line, the population and land uses in and near the line corridor, and state when that line capacity will become insufficient. The energy discussion should include preferred and alternative line routes, reliability, safety, design features, description of towers and foundations, material type of conductors, mid-span ground clearance, spacing between phases, etc., static or lighting protection, insulators, right of way requirements, planned operational voltage and critical voltage, electrical effects such as corona loss, ozone generation, electric power losses, and the creation of electromagnetic fields.

The energy/power line discussion should include the expected location of the construction workforce housing, a discussion of the right of way survey, tower spotting, and the following activities: clearing, road building, foundation installation, tower assembly, conductor installation, cleanup and reclamation, and maintenance.

TRANSPORTATION AND SHIPPING

Please describe the mode of transportation for materials to the site and wastes and product away from the site, including access routes, modification of existing traffic patterns, an estimate of the additional traffic to run on the access routes, vehicle emissions, and the method of materials containment during transport.

Include discussion of the possible hazards associated with this transportation, any safety precautions, and the emergency procedure should an accident occur. The location of any storage facilities or transfer stations should be identified. Please describe how the facility train and truck traffic will comply with state and federal transportation and environmental regulations.

SCENIC AND RECREATIONAL IMPACT

The possible effect on tourism from creation of the open pits and

04-17-95 11:40AM [58] #12

other mine impacts should be discussed. Please describe the project area's current scenic resources, their location, extent, and significance to the area, including any archeological and historic resources. Please state if these sites are registered or eligible to be registered.

Please analyze the project area's outdoor, resource-oriented recreational opportunities including locations and types of the recreational resources.

One possible mitigation would be requiring Glamis/Chemgold to reclaim the nearby areas degraded other old mining operations.

DESCRIPTION OF VEGETATION AND CLIMATE

Please discuss the regional vegetation, including proposed seed mixes for stabilization and reclamation. Please describe the climatic patterns, meteorology, rainfall and snowfall.

CONSTRUCTION AND PRODUCTION INFORMATION

Please state when construction is expected to commence, the construction time, estimated construction costs and payroll, total facility cost, estimate of cost of facility subject to use tax, property tax, income, severance and sales tax, as applicable.

Please list the anticipated numbers and job classifications by calendar quarter of employees of the applicant, its contractors, and subcontractors during the construction, and in a separate tabulation, during the operating life of the facility, including seasonal fluctuations, peak employment during both construction and operation, annual payroll, and the expected benefits, including housing allowances, transportation allowances, per diem allowances, pension and health benefits.

Please predict the number of employees to be utilized during construction, operation and maintenance of the facility that do not currently reside within 75 miles of the facility, and the number who do not currently reside within Nevada.

Please describe the methods how Glamis/Chemgold will maximize utilization of local contractors and the local labor force.

SOCIO-ECONOMIC INFORMATION

Please include a study of the area economy, including employment projections by major sector, economic bases and trends in the local economy, estimates of basic and non-basic employment, unemployment rates, a study of the area population, including a description of the methodology used, an evaluation of demographic characteristics for the current population, and projections of the area population without the proposed industrial facility.

Please include a fiscal analysis for all local governments and special districts that may be affected by the proposed facility, including revenue structure, expenditure levels, mill levies, services provided through public financing. and problems in providing public services Please

include such services as water supply, solid waste, sewer and waste water and stormwater collection and treatment, library, police, fire, school, social service, health care. and recreational facilities, existing service levels, problems, needs, necessary improvements and expansions. and those related costs.

The discussion on schools should include ratio of students to teachers, enrollment per grade, average class size, physical facilities and their capacities, and vocational training programs.

Please analyze the area's housing facilities by type, the number of units in the area, the current and projected vacancy rates, costs, and rental rates.

Please analyze the project area's transportation facilities, including roads, (surface, type and mileage) and railroads (frequency of service, tonnage capacity, and mileage).

SOCIO-ECONOMIC IMPACTS

The proposed mine expansion will increase the short term construction work force significantly. These workers could be imported from other areas. The recent FEIS for the Barrick/Betze mine in Nevada estimated that 70% of the workers in the peak construction work force for that expansion are imported.

If Glamis/Chemgold hires this proportion of out of state workers, there will be a significant, unmitigated impact on local social services.

This transient increase in the labor force burdens local social services, such as schools, roads, hospitals, jails, and welfare. This increased cost to social services should be estimated. Mitigation payments from the construction company to local city and county government to compensate for the mine's construction and its associated burdens on social services should also be estimated.

In the past, many non-Nevada companies have been major mine construction contractor. If an out of state contractor is hired for the proposed project, there will be negative socioeconomic impacts. These potential negative impacts should be studied as part of the scoping process for the DEIS.

If an out of state contractor imports almost all of its construction crew, there is little economic benefit to the local area from the construction activity. But an out of state construction work force places heavy demands on the local government infrastructure, principally on housing and campgrounds, roads, health care, schools, and police.

Many construction workers could come and go for the life of the project. Scores of out of state production workers could come and go, as different crafts and skills are in demand during the life of the mine.

The estimates of economic benefits from the construction and production work force of mine should include the probability that Glamis/Chemgold will import most of their construction and production work force, and run some long term mine functions by importing out of state workers.

An out of area contractor performing continuous functions at the mine would reduce the number of jobs for local workers in the daily operation of this facility. This would affect any estimate of socioeconomic benefits.

In summary, the DEIS' estimates of the socioeconomic impact of this project, and the descriptions of possible alternative configurations of the project, should scrutinize the economic burdens from an imported construction and production work force. This burden should be contrasted with the project alternative of a local construction and production work force that is paid prevailing area wages and which receives a health plan.

Discussion of project alternatives should include possible mitigations for the project that would increase local hiring of construction labor. This could be accomplished with a local hire or prevailing wage requirement as a condition of this DEIS and this mine's plan of operation.

The DEIS could also mandate specific sums of mitigation payments to schools, police, health care, pollution control agencies and other agencies that must police and serve the mine and its work force. Wyoming, California and Utah require industries to pay for many expansions of public services out of its own pocket as an up-front development cost.

Wyoming, for instance, has an industrial siting commission that calculates the mitigation payments required for the construction work force impacts by new projects. Recent mine expansions in Green River, Wyoming were required to pay $112,000 to area schools to mitigate the increased enrollment from its construction work force.

Lacking appropriate mitigation, the DEIS should list the economic and social consequences of an imported construction labor force (and imported mine work force) to be an unmitigated significant impact on all social services.

MANCAMP

The DEIS should also consider the impact of inappropriate actions by persons associated with the proposed project. This includes vandalism and poaching, taking of fish and wild life, materials spills and adverse actions by vendors supplying hazardous materials to the project.

This is particularly important regarding this project if there is a proposed mancamp. At other mine sites in Nevada, mancamps and widespread camping out by transient construction work forces contributed to

04-17-95 11:41AM [58] #15

widespread poaching and killing of wildlife, and vandalism and degradation of formerly secluded natural areas that are inappropriate for extended human habitation.

LOCAL PAYROLL AND LOCAL SPENDING

The DEIS should use variations of the following calculations to determine the financial strain on public services caused by an imported construction work force.

A locally hired construction work force spends 95% of its income in the local economy. This would multiply the favorable economic impact. In contrast, an imported work force spends only about one-half its income locally. So in comparison, an imported work force would reduce local spending and decrease the economic benefit of the construction phase of the proposed project.

The DEIS for the recent Barrick mine expansion in Nevada estimates that 70% of that mine's peak construction work force would be from out of state. Assume a similar percentage for the Glamis/Chemgold construction work force.

SCHOOLS

If out-of-state workers arrive for the proposed project, 70% of them will be married, 50% will bring their families, who will have an average of 1 children. Many additional children may be placed in local schools. It may cost the school system an additional thousands of dollars per child per school year to educate these children. This means that the out of state work force will cause an annual financial impact on the local schools.

This increase in enrollment may force capital expansion of the school system. Expanding the capital expansion of a school system costs $9000 per additional student who enrolls in already overcrowded schools. If the schools in the project area are overcrowded and forced to expand, they will be forced to spend large sums to accommodate the importation of families by an out of state work force. It is appropriate to consider the peak construction labor force in this calculation because the schools must meet this peak load of students.

In Challis, Idaho, for instance, community tax dollars were spent to build a junior high school that was boarded up when the construction boom (involving many TIC workers) from the Cyprus Thompson mine ended. Eureka, Nevada experienced a 50% increase in school enrollment from 1988-89 in part because of an influx of the children of mine construction workers, many from TIC. In Salmon, Idaho, according to county commissioner Quinton Snook, "(W)e built the new high school figuring the Cobalt (mine) money woul pay for it. Then Cobalt dies and the taxpayers picked up the tab." (Post Register, Idaho Falls, Idaho, 7/23/89)

REDUCED WELFARE AND UNEMPLOYMENT PAYMENTS

04-17-95 11:42AM [58] #16

The imported workers will take jobs that could have been filled by local, unemployed workers. Local unemployed workers could have been taken off the welfare and unemployment rolls instead. The predominantly imported work force will cost government coffers about $1.6 million in additional unemployment payments to local workers who stay unemployed. There is also an increased cost in continued welfare payments to unemployed local workers that should be calculated in the DEIS.

INCREASED IMPACT ON HEALTH CARE PROVIDERS

Many of these imported construction workers will seek medical care at local health care facilities. To illustrate this possible impact, in one 14 month period, there were 101 injured construction workers who filed workers compensation claims from the Cyprus Thompson mine job in Custer County, Idaho. These numbers indicate there may be many injured workers from the proposed construction work force who seek care. Local hospitals will be stretched thin.

Many workers may have no health care at the start of a construction job. If they are hurt, who will pay? The hospital or physician who treats these workers may end up passing the costs of that unpaid treatment on to the taxpayers and the paying customers of the hospital or doctor.

FINANCIAL IMPACT ON HEALTH CARE PROVIDERS

Some of the imported construction workers at Glamis/Chemgold will have 50 spouses and 76 children. The national average for one person's annual medical care is $2000. Assuming the construction work force and their families require one-half this amount of health care, and 15% of this group lacks health insurance, then local health care facilities must provide thousands of dollars in potentially uncompensated medical assistance to this group.

The DEIS should set out mitigation payments to local health care facilities for treatment of these temporary construction workers and their families.

FINANCIAL IMPACT ON THE BLM

The preparation of the EIS and the policing of the mine operations by the BLM will require a large commitment of BLM staff. The cost of this commitment should be stated in the DEIS, and borne by the applicant to mitigate the adverse financial impact on this public agency.

MINE CLOSURE

How will the mine closure affect local employment, economics, transportation, housing, public utility service, social services, local state and federal government, public government services, and schools?

What will be done to mitigate any of these negative impacts?

The EIS should contain a chart showing changes in the total numbers and percentages of the employment and unemployment rate for the entire

04-17-95 11:43AM (58) #17

workforce of the counties surrounding Glamis, and also for the construction and mine workforce. Other charts should show changes in the numbers of children in the local schools, and changes in the crime rates, f nearby cities and the surrounding counties. All these charts should provide yearly totals over the last ten years.

UNITED STATES MARINE CORPS
MARINE CORPS AIR STATION
BOX 99100
YUMA, ARIZONA 85369-9100

IN REPLY REFER TO:
11000
3AQ
18 Apr 95

Mr. Jesse Soriano
Imperial County Planning/Building Department
939 Main Street
El Centro, CA 92243-2856

Dear Mr. Soriano:

We received a Notice of Preparation from Imperial County, CA for Chemgold Inc. Subject corporation is proposing the development and operation of an open pit gold and silver mine and heap leach recovery operation known as the Imperial Project.

During our office review of the preparation report, we have found that we still have questions and concerns that must be addressed before we can make a final determination of this Command's position on this project.

At this time, our current concerns are as follows:

a. **Exact location.** We have been provided a legal description for 11 sections. Total acreage for subject sections is over 7000 acres. Project has been estimated at approximately 1600 acres. Exact location is crucial because, at this time, we have found that the property appears to be located under two military Visual Flight Rules (VFR) low-level flying routes for fixed wing aircraft that have minimum altitudes of 300' and 200', respectively, above ground level. One of the routes, VFR 299, is owned and controlled by the 445th Military Airlift Wing (March Air Force Base). The other route is VFR 1266 that is owned and controlled by Marine Air Group-13 stationed at MCAS Yuma..

b. **Guy wires.** Because of the military low-level routes in this area, this is a major concern for the health, safety and welfare of everyone concerned.

c. **Vertical obstruction.** Height of towers, cranes, telephone poles, etc. also pose concerns because of our military low-level routes.

d. **Attraction of birds.** Must ask for prohibition of any use of the land which would unnecessarily attract birds. Birdstrikes cause extreme damage and, at times, have caused aircraft crashes.

e. **Air emissions-** Must ask for prohibition of any release into the air of any substance which would impair the visibility or otherwise interfere with the operations of aircraft, such as, but not limited to, steam, dust and smoke.

f. **Electrical emissions-** Must ask for prohibition of electrical emissions which would interfere with aircraft and aircraft communications systems or aircraft navigational equipment.

g. **Light emissions-** Must ask for prohibition of light emissions, either direct or indirect (reflective), which might interfere with pilot vision. In addition to our 2 military low-level routes that we previously addressed, we also have numerous low-level helicopter routes in this area that use Night Vision Goggles (NVG). Light would render these routes useless for our NVG helicopter pilot training.

We would be amenable to working with your staff to resolve any problems that could or might arise with this project. If you have any questions, you can call me at (520)341-2103/2272.

Thank you for this opportunity to comment.

Sincerely,

T. A. MANFREDI
Community Planner
By direction of the
Commanding Officer

ENVIRONMENTAL MANAGEMENT ASSOCIATES

MEMORANDUM

TO: Keith Shone - Bureau of Land Management (BLM)
Jesse Soriano - Imperial County Planning Department (ICPD)
C. Kevin McArthur - Chemgold, Inc. (Chemgold)

FROM: Dwight L. Carey / Eric R. Mintz

SUBJECT: Chemgold Imperial Project EIS/EIR - Public Comments Received During April 17, 1995 and April 18, 1995 Public Scoping Meetings

DATE: April 25, 1995

Locations: April 17, 1995 - El Centro Community Center
April 18, 1995 - Yuma Days Inn Suites

Attendees:

BLM:
Keith Shone - Environmental Coordinator
Tom Zale - Chief of Resources

Environmental Management Associates (EMA):
Dwight Carey - Principal and Project Manager
Eric Mintz - Environmental Specialist and Document Coordinator

Chemgold, Inc.
C. Kevin McArthur - Vice President and General Manager

Imperial County Planning Department
Jesse Soriano - Planner III

Public
April 17, 1995 - None
April 18, 1995 - See Attached List

COMMENTS:

April 17, 1995

There were no public attendees, so no comments were received.

April 18, 1995

Following an introduction by Tom Zale and a discussion of the proposed project by Kevin McArthur, the following verbal comments were received:

Rusty McBride/Carol Sassie

- The project will result in significant impacts to deer populations, principally doe and fawn, which utilize and move through the Project area.
- Bighorn sheep will also likely be impacted by the project, as they have been observed in the area.

Steve Baumann

- The EIS should address the positive economic benefits of the proposed project, particularly employment.

Larry Todd

- Because Imperial County is looking at a loss in tax revenue since the American Girl and Picacho Mines are nearing their expected mining lives, what economic impact will the project have on the population affected by the eventual closing of these mining operations?

Ed Kirwan

- With adequate mitigation measures, all potential impacts resulting from the project can be mitigated, thus benefitting the area.

MEETING ROSTER
IMPERIAL PROJECT PLAN OF OPERATION
EIS PUBLIC SCOPING MEETING

NAME	ORGANIZATION	ADDRESS	PHONE NUMBER
Jesse Soriano	ICPD	939 Main El Centro, CA 92243	619 359-4230
Dan Rovig	Glamis Gold	715 Greg St. Sparks, NV 89431	702 356-0147
Carol Sassie	State of Calif Fish & Game	P.O. Box 1673 Brawley, CA 92227	619 344-8139
Ron Wyrick	Chemgold, Inc.	1325 Hayward Ave #181 Yuma, AZ, 85364	520 341-1893
ROBERT JOHNS	CHEMGOLD, INC.	1905 WEST DEL PLATA LN YUMA AZ, 85364	520 782-0374
Rick Thompson	Western Ecosystems, Inc	905 W Coach Rd Boulder, CO 80302	(303) 442-6144
Ed Kirwan	American Girl Mining Joint Venture	PO Box 4468 Yuma, AZ 85366	(520) 783-2646
Michelle Gale	Chemgold, Inc.	1334 S. Ave B #88 Yuma, AZ 85364	(520) 782-7354
Alex Ruzycki	SFPG - Mesquite	1963 W. 12th Lane Yuma, AZ 85364	(520) 343-1191
Gary Boyle	Chemgold, Inc.	PO BOX 715 Winterhaven CA. 92283	(620) 341-1893

RECEIVED FROM 619 337 4490 04.21.1995 16:29 P. 3

04/21/95 15:30 ☎619 337 4490 EL CENTRO BLM 003

MEETING ROSTER
IMPERIAL PROJECT PLAN OF OPERATION
EIS PUBLIC SCOPING MEETING

NAME	ORGANIZATION	ADDRESS	PHONE NUMBER
Larry Todd	SFPG-Mesquite	6502 E. HWY 78 Brawley, CA 92227	(619) 352-6541 ext. 169
Jim Voorhees	SFPG-Mesquite	6502 E. HWY 78 Brawley, CA 92227	(619) 352-6541 EXT. 103
Tim Leftwich	SFPG-ALBQ.	P.O. Box 27019 Albq. NM 87125	505-880-5343
Tom Manfredi	MCAS-Yuma	Box 99106 Yuma, AZ 85369-9106	520-341-2272/2103
Rusty McBride	CA. Fish & Game	P.O. Box 238 Winterhaven, Ca. 92283	520-783-2866
Steve Baumann		2270 San Marcos Dr Yuma AZ 85365	520.317.0548
Dennis Vaughn	SFPG-Mesquite	6502 E Hwy 78 Brawley, Ca 9222	619 352 6541
Dan Dunnance	Chemgold Inc	Yuma, AZ	602-783-1891

Steve Baumann
2270 San Marcos Dr.
Yuma, AZ 85365

Bureau of Land Management, El Centro Resource Area
1661 South 4th St.
El Centro, CA 92243-7461
Attn: Tomas Zale

April 19, 1995

Mr. Zale:

I would like to comment on the proposed Imperial Project EIS currently being performed by your agency.

I believe the EIS process, while well intended, has a fatal flaw that was not envisioned when it was enacted by congress. That flaw is the minimal role, generally outlined in the socio-economic section, that is allowed for the positive economic benefits each project may bring to the 'local environment'.

We, as human beings, are a major part of the 'local' environment we live in. There are two (2) very important items we must have to allow us to take advantage of the positive impacts generated by the preservation of our environment. Those items are disposable income, and disposable time. Without these two, we are either forced to leave the area, or spend the majority of our time surviving and are not in a position to enjoy our surroundings.

This project has the potential to provide many people in the surrounding area both of these items. This mine would provide many well paid jobs. Not minimum wage jobs, but those that are generally higher than the average. These higher wages, coming from stable jobs, will provide both disposable time and income. The company will also be a major consumer in the area. This will provide additional economic benefits to store owners and local government, multiplying the disposable time and income in the community. These items add to the tax base which enables the Department of Fish and Game, and the Wildlife Service to continue to employ biologists to study the flora and fauna of the area. This provides the link between environment and economics which is so often lost.

These people will use this income to utilize the 'dunes' environment or to purchase boats to utilize the 'river and lakes' environments in our area. Without the disposable income and time, their ability to enjoy these segments of our environment is diminished, or lost.

Without an economic base in the area, the environment has minimal value. I believe for these reasons it is imperative that a broader section discussing the positive economic benefits be included in the EIS/EIR process. This would eliminate the currently biased, study the environment at all costs, system of review.

Always,

Steve Baumann

STATE OF CALIFORNIA - RESOURCES AGENCY

RECEIVED

PETE WILSON, Governor

DEPARTMENT OF CONSERVATION
Office of Mine Reclamation
Reclamation Unit

MAY 01 1995

IMPERIAL COUNTY
BUILDING INSPECTION

FILE COPY

Post-it™ Fax Note 7671	Date 5/2/95 # of pages ▶ 3
To Eric Munly	From Jesse Soriano
Co./Dept.	Co.
Phone #	Phone # 339-4320
Fax # 714-529-8543	Fax #

April 24, 1995

Jesse Soriano
Imperial County Planning Department
939 Main Street
El Centro, CA 92243-2856

Notice of Preparation of a Draft Environmental Impact Report and Environmental Impact Statement
Chemgold, Inc. Imperial Project

Dear Mr. Soriano:

The Office of Mine Reclamation of the Department of Conservation has reviewed the Notice of Preparation for the Chemgold, Inc. Imperial Project. This project will be located north of the Cargo Muchacho Mountains in the general vicinity of Black Mountain in eastern Imperial County. The project will encompass approximately 1,400 acres of new surface disturbance. The proposed project must comply with the requirements of the Surface Mining and Reclamation Act of 1975 (SMARA) (Public Resources Code Section 2710 et seq.) and the State Mining and Geology Board regulations for surface mining and reclamation practice (California Code of Regulations (CCR) Title 14, Chapter 8, Article 1, Section 3500 et seq.; Article 9, Section 3700 et seq.).

The Office of Mine Reclamation recommends that the Draft Environmental Impact Report/Environmental Impact Statement (DEIS/DEIR) specifically address the following items:

1. SMARA was recently amended by Assembly Bill 867 which became effective January 1, 1995. Under this amendment, information that has been prepared as part of a permit application or pursuant to the California Environmental Quality Act (CEQA) may be included in the project's reclamation plan by reference, if that item of information is attached to the reclamation plan when it is forwarded to the Department for review. To the extent that the referenced information is used to meet SMARA requirements, the information will become part of the reclamation plan and subject to all other requirements of SMARA, including calculation of financial assurances. We recommend that the reclamation plan be prepared as an integral part of the DEIS/DEIR and that it not be finalized prior to formulation

of mitigation measures and the development of a mitigation monitoring plan pursuant to the California Environmental Quality Act (CEQA) and the National Environmental Policy Act (NEPA).

2. The reclamation plan should provide geotechnical analyses to demonstrate that the pit and leach facility design will have long term stability. Instability of pit slopes has been observed in other open pit mines in the nearby Cargo Muchacho Mountains.

3. Revegetation of this arid site will be difficult. We strongly recommend that the revegetation plan developed for this project provide for salvage of all growth media, conservation of native vegetation, and use of site-indigenous native species for revegetation. The project should be designed so that test plots can be established at the onset of mining, with test plot data incorporated into the final revegetation plan.

4. The environmental document should carefully analyze water availability and its source, and provide specific mechanisms to determine if water use will result in an adverse environmental impact, such as depletion of flows from any springs. We recommend that the applicant contact Mr. Frank Melbourn (619) 467-2973, of the Regional Water Quality Control Board, to determine what water quality requirements are applicable to this operation.

5. The project is within the range of several sensitive species, including Nelson's bighorn sheep (*Ovis canadensis nelsoni*) and the desert tortoise (*Xerobates agassizii*) and may include desert riparian habitat. We recommend that biological surveys be conducted during appropriate times of the year to determine if the site supports sensitive species. Information on sensitive species habitat requirements and determination of appropriate survey protocols should be determined in consultation with the U.S. Fish and Wildlife Service and the California Department of Fish and Game. Identification of sensitive species utilization of the site will be essential to the development of adequate reclamation measures under SMARA and mitigation measures under CEQA and NEPA.

Please send a copy of the draft environmental documents when they are prepared. At that time, OMR staff will make arrangements to conduct a site visit of the proposed project and discuss reclamation plan requirements.

If you have any questions on these comments or require any assistance with other mine reclamation issues, please contact me at (916) 323-8565.

Sincerely,

James S. Pompy, Manager
Reclamation Unit

cc: OGER

STATE OF CALIFORNIA - BUSINESS, TRANSPORTATION AND HOUSING AGENCY PETE WILSON, Governor

DEPARTMENT OF TRANSPORTATION

DISTRICT 11, P.O. BOX 85406, SAN DIEGO, 92186-5406
(619) 693-6424 TDD Number
(619) 688-6002

RECEIVED
MAY 01 1995
IMPERIAL COUNTY
BUILDING INSPECTION

April 28, 1995

11-IMP-008, 078
VAR Imperial County

Mr. Jesse Soriano
Imperial County Planning/Building Department
939 Main Street
El Centro, CA 92243-2856

Dear Mr. Soriano:

Notice of Preparation (NOP) for the Imperial Project-SCH 95041025

Caltrans District 11 comment is as follows:

- Under the topic of Transportation, the Environmental Impact Report (EIR) should address the number of trucks per day expected to use Interstate Route 8 (I-8) or State Route 78 (SR-78).

Our contact person for I-8 is Mark Parra, Design Branch, (619) 688-6952. For SR-78 our contact person is John Kempf, Project Engineer, (619) 688-6994.

Sincerely,

L. Salazar

for BILL DILLON, Chief
Planning Studies Branch

BD/LS:ek

DEPARTMENT OF FISH AND GAME
330 GOLDEN SHORE, SUITE 50
LONG BEACH, CA 90802
(310) 590-5113

RECEIVED MAY 12 1995
RECEIVED
MAY 10 1995
IMPERIAL COUNTY
BUILDING INSPECTION

May 8, 1995

Mr. Jesse Soriano
Imperial County Planning Building
939 Main Street
El Centro, California 92243

Dear Mr. Soriano:

Notice of Preparation of Draft Environmental Impact Report
Imperial Project
SCH 95041025, Imperial County

The Department of Fish and Game (Department) appreciates this opportunity to comment on the above-referenced project, relative to impacts to biological resources. To enable Department staff to adequately review and comment on the proposed project, we recommend the following information be included in the draft Environmental Impact Report:

1. A complete assessment of the flora and fauna within and adjacent to the project area, with particular emphasis upon identifying endangered, threatened, and locally unique species and sensitive habitats.

   a. A thorough assessment of rare plants and rare natural communities, following the Department's May 1984 Guidelines for Assessing Impacts to Rare Plants and Rare Natural Communities (Attachment 1).

   b. A complete assessment of sensitive fish, wildlife, reptile, and amphibian species. Seasonal variations in use of the project area should also be addressed. Focused species-specific surveys, conducted at the appropriate time of year and time of day when the sensitive species are active or otherwise identifiable, are required. Acceptable species-specific survey procedures should be developed in consultation with the Department and the U.S. Fish and Wildlife Service.

   c. Rare, threatened, and endangered species to be addressed should include all those which meet the California Environmental Quality Act (CEQA) definition (see CEQA Guidelines, §15380).

d. The Department's California Natural Diversity Data Base in Sacramento should be contacted at (916) 327-5960 to obtain current information on any previously reported sensitive species and habitat, including Significant Natural Areas identified under Chapter 12 of the Fish and Game Code.

2. A thorough discussion of direct, indirect, and cumulative impacts expected to adversely affect biological resources, with specific measures to offset such impacts.

a. CEQA Guidelines, §15125(a), direct that knowledge of the regional setting is critical to an assessment of environmental impacts and that special emphasis should be placed on resources that are rare or unique to the region.

b. Project impacts should be analyzed relative to their effects on off-site habitats. Specifically, this should include nearby public lands, open space, adjacent natural habitats, and riparian ecosystems. Impacts to and maintenance of wildlife corridor/movement areas, including access to undisturbed habitat in adjacent areas, should be fully evaluated and provided.

c. A cumulative effects analysis should be developed as described under CEQA Guidelines, §15130. General and specific plans, as well as past, present, and anticipated future projects, should be analyzed relative to their impacts on similar plant communities and wildlife habitats.

3. A range of alternatives should be analyzed to ensure that alternatives to the proposed project are fully considered and evaluated. A range of alternatives which avoid or otherwise minimize impacts to sensitive biological resources should be included. Specific alternative locations should also be evaluated in areas with lower resource sensitivity where appropriate.

a. Mitigation measures for project impacts to sensitive plants, animals, and habitats should emphasize evaluation and selection of alternatives which avoid or otherwise minimize project impacts. Off-site compensation for unavoidable impacts through acquisition and protection of high-quality habitat elsewhere should be addressed.

b. The Department considers Rare Natural Communities as threatened habitats having both regional and local significance. Thus, these communities should be fully avoided and otherwise protected from project-related impacts (Attachment 2).

c. The Department generally does not support the use of relocation, salvage, and/or transplantation as mitigation for impacts to rare, threatened, or endangered species. Department studies have shown that these efforts are experimental in nature and largely unsuccessful.

4. If the project has the potential to adversely affect species of plants or animals listed under the California Endangered Species Act (CESA), either during construction or over the life of the project, a CESA-Memorandum of Understanding (CESA-MOU) must be obtained under §2081 of the Fish and Game Code. CESA-MOU's are issued to conserve, protect, enhance, and restore State-listed threatened or endangered species and their habitats. Early consultation is encouraged, as significant modification to a project and mitigation measures may be required in order to obtain a CESA-MOU.

a. Biological mitigation proposals should be of sufficient detail and resolution to satisfy the requirements for a CESA-MOU.

b. A Department-approved Mitigation Agreement and Mitigation Plan are required for plants listed as rare under the Native Plant Protection Act.

5. The Department opposes the elimination of watercourses and/or their channelization or conversion to subsurface drains. All wetlands and watercourses, whether intermittent or perennial, must be retained and provided with substantial setbacks which preserve the riparian and aquatic values and maintain their value to on-site and off-site wildlife populations.

a. The Department has direct authority under Fish and Game Code §1600 et. seq. in regard to any proposed activity which would divert, obstruct, or affect the natural flow or change the bed, channel, or bank of any river, stream, or lake. Departmental jurisdiction under §1600 et. seq. applies to all lands within the 100-year floodplain. Early consultation is recommended, since modification of the proposed project may be required to avoid or reduce impacts to fish and wildlife resources.

b. A discussion of potential adverse impacts from any increased runoff, sedimentation, soil erosion, and/or urban pollutants on streams and watercourses on or near the project site, with mitigation measures proposed to alleviate such impacts must be included.

Thank you for this opportunity to comment. Questions regarding this letter and further coordination on these issues should be directed to Ms. Nancy Andrew, Wildlife Biologist, (619) 351-1676.

Sincerely,

Julia J Martinez for

Patricia Wolf
Acting Regional Manager
Region 5

Attachments

cc: Ms. Nancy Andrew
Department of Fish and Game
Brawley, California

Mr. Gerald Mulcahy
Department of Fish and Game
Blythe, California

Ms. Carol Sassie
Department of Fish and Game
Brawley, California

Ms. Terri Dickerson
Department of Fish and Game
Laguna Niguel, California

Mr. Terry Foreman
Department of Fish and Game
San Diego, California

Mr. Jim Dice
Department of Fish and Game
Borrego Springs, California

U.S. Fish and Wildlife Service
Carlsbad, California

U.S. Army Corps of Engineers
Los Angeles, California

State Clearinghouse
Sacramento, California

State of California
THE RESOURCES AGENCY
Department of Fish and Game
May 4, 1984

GUIDELINES FOR ASSESSING THE EFFECTS OF PROPOSED DEVELOPMENTS ON RARE AND ENDANGERED PLANTS AND PLANT COMMUNITIES

The following recommendations are intended to help those who prepare and review environmental documents determine when a botanical survey is needed, who should be considered qualified to conduct such surveys, how field surveys should be conducted and what information should be contained in the survey report.

1. Botanical surveys that are conducted to determine the environmental effects of a proposed development should be directed to all rare and endangered plants and plant communities. Rare and endangered plants are not necessarily limited to those species which have been "listed" by state and federal agencies but should include any species that, based on all available data, can be shown to be rare and/or endangered under the following definitions.

   A species, subspecies or variety of plant is "endangered" when the prospects of its survival and reproduction are in immediate jeopardy from one or more causes, including loss of habitat, change in habitat, over-exploitation, predation, competition or disease. A plant is "rare" when, although not presently threatened with extinction, the species, subspecies or variety is found in such small numbers throughout its range that it may be endangered if its environment worsens.

   Rare plant communities are those communities that are of highly limited distribution. These communities may or may not contain rare or endangered species. The most current version of the California Natural Diversity Data Base's Outline of Terrestrial Communities in California may be used as a guide to the names of communities.

2. It is appropriate to conduct a botanical field survey to determine if, or the extent that, rare plants will be affected by a proposed project when:

   a. Based on an initial biological assessment, it appears that the project may damage potential rare plant habitat;

   b. Rare plants have historically been identified on the project site, but adequate information for impact assessment is lacking; or

   c. No initial biological assessment has been conducted and it is unknown whether or not rare plants or their habitat exist on the site.

3. Botanical consultants should be selected on the basis of possession of the following qualifications (in order of importance):

   a. Experience as a botanical field investigator with experience in field sampling design and field methods;

   b. Taxonomic experience and a knowledge of plant ecology;

   c. Familiarity with the plants of the area, including rare species; and

   d. Familiarity with the appropriate state and federal statutes related to rare plants and plant collecting.

4. Field surveys should be conducted in a manner that will locate any rare or endangered species that may be present. Specifically, rare or endangered plant surveys should be:

   a. Conducted at the proper time of year when rare or endangered species are both "evident" and identifiable. Field surveys should be scheduled (1) to coincide with known flowering periods, and/or (2) during periods of phenological development that are necessary to identify the plant species of concern.

b. Floristic in nature. "Predictive surveys" (which predict the occurrence of rare species based on the occurrence of habitat or other physical features rather than actual field inspection) should be reserved for ecological studies, not for impact assessment. Every species noted in the field should be identified to the extent necessary to determine whether it is rare or endangered.

c. Conducted in a manner that is consistent with conservation ethics. Collections of rare or suspected rare species (voucher specimens) should be made only when such actions would not jeopardize the continued existence of the population and in accordance with applicable state and federal permit regulations. Voucher specimens should be deposited at recognized public herbaria for future reference. Photography should be used to document plant identification and habitat whenever possible, but especially when the population cannot withstand collection of voucher specimens.

d. Conducted using systematic field techniques in all habitats of the site to ensure a reasonably thorough coverage of potential impact areas.

e. Well documented. When a rare or endangered plant (or rare plant community) is located, a California Native Species (or Community) Field Survey Form or equivalent written form should be completed and submitted to the Natural Diversity Data Base.

5. Reports of botanical field surveys should be included in or with environmental assessments, negative declarations, EIR's and EIS's, and should contain the following information:

a. Project description, including a detailed map of the project location and study area.

b. A written description of biological setting referencing the community nomenclature used and a vegetation map.

c. Detailed description of survey methodology.

d. Dates of field surveys.

e. Results of survey (including detailed maps).

f. An assessment of potential impacts.

g. Discussion of the importance of rare plant populations with consideration of nearby populations and total species distribution.

h. Recommended mitigation measures to reduce or avoid impacts.

i. List of all species identified.

j. Copies of all California Native Species Field Survey Forms or Natural Community Field Survey Forms.

k. Name of field investigator(s).

l. References cited, persons contacted, herbaria visited, and disposition of voucher specimens.

ATTACHMENT 2

Sensitivity of Top Priority Rare Natural Communities in Southern California*

Sensitivity rankings are determined by the Department of Fish and Game, alifornia Natural Diversity Data Base and based on either number of known ccurrences (locations) and/or amount of habitat remaining (acreage). The ree rankings used for these top priority rare natural communities are as ollows:

1.- Less than 6 known locations and/or on less than 2,000 acres of habitat remaining

2.- Occurs in 6-20 known locations and/or 2,000-10,000 acres of habitat remaining

3.- Occurs in 21-100 known locations and/or 10,000-50,000 acres of habitat remaining

The number to the right of the decimal point after the ranking refers to e degree of threat posed to that natural community regardless of the ranking example:

S1.1 = very threatened
S2.2 = threatened
S3.3 = no current threats known

Sensitivity Rankings (February 1992)

ank	Community Name
1.1	Mojave Riparian Forest
	Sonoran Cottonwood Willow Riparian
	Mesquite Bosque
	Elephant Tree Woodland
	Crucifixion Thorn Woodland
	Allthorn Woodland
	Arizonan Woodland
	Southern California Walnut Forest
	Mainland Cherry Forest
	Southern Bishop Pine Forest
	Torrey Pine Forest
	Desert Mountain White Fir Forest
	Southern Dune Scrub
	Southern Coastal Bluff Scrub
	Maritime Succulent Scrub
	Riversidean Alluvial Fan Sage Scrub
	Southern Maritime Chaparral
	Valley Needlegrass Grassland
	Great Basin Grassland
	Mojave Desert Grassland
	Pebble Plains
	Southern Sedge Bog
	Cismontane Alkali Marsh

Sensitivity Rankings (Cont.)

Community Name

2
- Southern Foredunes
- Mono Pumice Flat
- Southern Interior Basalt Fl. Vernal Pool

1
- Venturan Coastal Sage Scrub
- Diegan Coastal Sage Scrub
- Riversidean Upland Coastal Sage Scrub
- Riversidean Desert Sage Scrub
- Sagebrush Steppe
- Desert Sink Scrub
- Mafic Southern Mixed Chaparrel
- San Diego Mesa Hardpan Vernal P.
- San Diego Mesa Claypan Vernal P.
- Alkali Meadow
- Southern Coastal Salt Marsh
- Coastal Brackish Marsh
- Transmontane Alkali Marsh
- Coastal and Valley Freshwater Marsh
- S. Arroya Willow Riparian Forest
- Southern Willow Scrub
- Modoc-G.Bas. Cottonwood Willow Rip.
- Modoc-Great Basin Riparian Scrub
- Mojave Desert Wash Scrub
- Engelmann Oak Woodland
- Open Engelmann Oak Woodland
- Closed Engelmann Oak Woodland
- Island Oak Woodland
- California Walnut Woodland
- Island Ironwood Forest
- Island Cherry Forest
- S. Interior Cypress Forest
- Bigcone Spruce-Canyon Oak Forest

2.2
- Active Coastal Dunes
- Active Desert Dunes
- Stab. and Part. Stab. Desert Dunes
- Stab. and Part. Stab. Desert Sandfield
- Mojave Mixed Steppe
- Transmontane Freshwater Marsh
- Coulter Pine Forest
- S. California Fellfield
- White Mountains Fellfield

3.2.3
- Bristlecone Pine Forest
- Limber Pine Forest

ELEMENT RANKING

GLOBAL RANKING

The *global rank* (G-rank) is a reflection of the overall condition of an element throughout its global range.

SPECIES LEVEL

G1 = Less than 6 viable EOs OR less than 1000 individuals OR less than 2000 acres.
G2 = 6-20 EOs OR 1000-3000 individuals OR 2000-10,000 acres.
G3 = 21-100 EOs OR 3000-10,000 individuals OR 10,000-50,000 acres
G4 = Apparently secure; this rank is clearly lower than G3 but factors exist to cause some concern; i.e. there is some threat, or somewhat narrow habitat.
G5 = Population demonstrably secure to ineradicable due to being commonly found in the world.

SUBSPECIES LEVEL

Subspecies receive a T-rank attached to the G-rank. With the subspecies, the G-rank reflects the condition of the entire species, whereas the T-rank reflects the global situation of just the subspecies.

For example: *Chorizanthe robusta* var. *hartwegii*.
This plant is ranked G2T1. The G-rank refers to the whole species range of *Chorizanthe robusta*. The T-rank refers only to the global condition of var. *hartwegii*.

STATE RANKING

The *state rank* is assigned much the same way as the global rank, except state ranks in California often also contain a threat number attached to the S-rank.

Less than 6 EOs OR less than 1000 individuals OR less than 2000 acres = S1:
- S1.1 = very threatened
- S1.2 = threatened
- S1.3 = no current threats known

6-20 EOs OR 1000-3000 individuals OR 2000-10,000 acres = S2:
- S2.1 = very threatened
- S2.2 = threatened
- S2.3 = no current threats known

21-100 EOs OR 3000-10,000 individuals OR 10,000-50,000 acres =S3:
- S3.1 = very threatened
- S3.2 = threatened
- S3.3 = no current threats known

S4 Apparently secure within California; this rank is clearly lower than S3 but factors exist to cause some concern; there is some threat, or somewhat narrow habitat. NO THREAT NUMBER.

S5 Demonstrably secure to ineradicable in California. NO THREAT NUMBER.

Notes:

Uncertainty about the rank of an element is expressed in two major ways:

By expressing the rank as a range of values: i.e. S2S3 means the rank is something between S2 and S3.

By adding a "?" to the rank:
i.e. S2? This represents more certainty than S2S3.

Other symbols:

SH All sites are historical; the element has not been seen for at least 20 years but suitable habitat still exists (SH = All California sites are historical).
SX All sites are extirpated; this element is extinct in the wild (SX = All California sites are extirpated).
SXC Extinct in the wild; exists in cultivation.
G1Q The element is very rare, but there is a taxonomic question associated with it.

Top Priority Rare Natural Communities From Region Five

Code Number	Location[1]	Few Records	Name
S1.1 Rank:			
21330	Cis		Southern Dune Scrub
31200	Cis		Southern Coastal Bluff Scrub
32400	Cis		Maritime Succulent Scrub
32720	Cis		Riversidean Alluvial Fan Sage Scrub
37C30	Cis	Y	Southern Maritime Chaparral
42110	Cis		Valley Needlegrass Grassland
43000	Des	Y	Great Basin Grassland
43777	Des	Y	Mojave Desert Grassland
47000	Cis		Pebble Plains
51177	Cis	Y	Southern Sedge Bog
52310	Cis		Cismontane Alkali Marsh
61700	Des		Mojave Riparian Forest
61810	Des		Sonoran Cottonwood Willow Riparian
61820	Des		Mesquite Bosque
75100	Des	Y	Elephant Tree Woodland
75200	Des	Y	Crucifixion Thorn Woodland
75300	Des	Y	Allthorn Woodland
75400	Des	Y	Arizonan Woodland
81600	Cis		Southern California Walnut Forest
81820	Cis	Y	Mainland Cherry Forest
83122	Cis	Y	Southern Bishop Pine Forest
83140	Cis		Torrey Pine Forest
85330	Des	Y	Desert Mountain White Fir Forest
S 1.2 Rank:			
21230	Cis		Southern Foredunes
35410	Des		Mono Pumice Flat
44310	Cis		Southern Interior Basalt Fl. Vernal Pool
S2.1 Rank:			
32300	Cis	Y	Venturan Coastal Sage Scrub
32500	Cis		Diegan Coastal Sage Scrub
32710	Cis	Y	Riversidian Upland Coastal Sage Scr.
32730	Cis	Y	Riversidean Desert Sage Scrub
35300	Des	Y	Sagebrush Steppe
36120	Des	Y	Desert Sink Scrub
37122	Cis	Y	Mafic Southern Mixed Chaparral
44321	Cis		San Diego Mesa Hardpan Vernal P.
44322	Cis		San Diego Mesa Claypan Vernal P.
45310	Des		Alkali Meadow
52120	Cis		Southern Coastal Salt Marsh
52320	Cis		Coastal Brackish Marsh
52410	Des		Transmontane Alkali Marsh

[1] coded as either cis (for cismontane) or des (for desert)

Code Number	Location[1]	Few Records	Name
52410	Cis		Coastal and Valley Freshwater Marsh
61320	Cis		S. Arroyo Willow Riparian Forest
63320	Cis		Southern Willow Scrub
61810	Des		Modoc-G.Bas. Cottonwood Willow Rip.
63600	Des	Y	Modoc-Great Basin Riparian Scrub
63700	Des	Y	Mojave Desert Wash Scrub
71180	Cis	Y	Engelmann Oak Woodland
71181	Cis	Y	Open Engelmann Oak Woodland
71182	Cis	Y	Closed Engelmann Oak Woodland
71190	Cis	Y	Island Oak Woodland
71210	Cis		California Walnut Woodland
81700	Cis	Y	Island Ironwood Forest
81810	Cis		Island Cherry Forest
83230	Cis		S. Interior Cypress Forest
84150	Cis	Y	Bigcone Spruce-Canyon Oak Forest
S2.2 Rank:			
21100	Cis	Y	Active Coastal Dunes
22100	Des		Active Desert Dunes
22200	Des		Stab. and Part. Stab. Desert Dunes
22300	Des	Y	Stab and Part. Stab. Desert Sandfield
34220	Des	Y	Mojave Mixed Steppe
52420	Des	Y	Transmontane Freshwater Marsh
84140	Cis	Y	Coulter Pine Forest
91130	Cis	Y	S. California Fellfield
91140	Des	Y	White Mountains Fellfield
S2.3 Rank:			
86400	Des		Bristlecone Pine Forest
86700	Des	Y	Limber Pine Forest

[1] coded as either cis (for cismontane) or des (for desert)

RECEIVED MAY 19 1995

ESTABLISHED IN 1918 AS A PUBLIC AGENCY

COACHELLA VALLEY WATER DISTRICT

POST OFFICE BOX 1058 • COACHELLA, CALIFORNIA 92236 • TELEPHONE (619) 398-2651

DIRECTORS
TELLIS CODEKAS, PRESIDENT
RAYMOND R. RUMMONDS, VICE PRESIDENT
JOHN W. McFADDEN
DOROTHY M. NICHOLS
THEODORE J. FISH

OFFICERS
THOMAS E. LEVY, GENERAL MANAGER-CHIEF ENGINEER
BERNARDINE SUTTON, SECRETARY
OWEN McCOOK, ASSISTANT GENERAL MANAGER
REDWINE AND SHERRILL, ATTORNEYS

May 12 1995

File: 1150.02

RECEIVED
MAY 16 1995
IMPERIAL COUNTY
BUILDING INSPECTION

Jesse Soriano
Imperial County Planning/Building
Department
939 Main Street
El Centro, California 92243

Dear Mr. Soriano:

We have reviewed the Notice of Preparation of a Draft Environmental Impact Report for the proposed Imperial Project, Open Pit Gold Mine. This project is located in eastern Imperial County and is many miles from the nearest district facility. The project is not expected to impact the district.

If you have any questions please contact Joe Cook, planning engineer, extension 292.

Yours very truly,

for Owen McCook
Tom Levy
General Manager-Chief Engineer

JEC:jl/e8/soriano

MWD
METROPOLITAN WATER DISTRICT OF SOUTHERN CALIFORNIA

Office of The General Manager

May 16, 1995

Mr. Jesse Soriano
Imperial County Planning Department
939 Main Street
El Centro, California 92243

Dear Mr. Soriano:

Notice of Preparation of a Draft
Environmental Impact Report for the Imperial Project

We have received the Notice of Preparation of a Draft Environmental Impact Report (EIR) for the Imperial Project in Imperial County. Chemgold, Inc., proposes to develop and operate an open pit gold and silver mine and heap leach recovery operation encompassing 1,383 acres. The comments herein represent the Metropolitan Water District's (Metropolitan) response as a potentially affected public agency.

Background

Metropolitan was formed in 1928 under an enabling Act of the California legislature. Historically, Metropolitan has provided supplemental water to the Southern California coastal plain to augment local water supplies developed by surface catchment, groundwater production, and wastewater reclamation. This supplemental water is delivered to 27 member agencies through a regional network of canals, pipelines, reservoirs, treatment plants, and appurtenant works. Metropolitan receives water from the California Aqueduct of the State Water Project and from the Colorado River Aqueduct for distribution to about 250 cities and unincorporated communities within a 5,200 square mile service area covering portions of Ventura, Los Angeles, Orange, Riverside, San Bernardino, and San Diego counties. Metropolitan currently provides about 55% of the water used in this service area, with remaining supplies consisting of local groundwater and surface water (37%) and water imported by the City of Los Angeles via the Los Angeles Aqueduct (8%).

All American Canal Lining Project

The U.S. Department of the Interior Bureau of Reclamation (Reclamation) has published the Final Environmental Impact Statement/EIR for the All American Canal (AAC) Lining Project and has issued a Record of Decision for the project. Implementation of the AAC Lining Project would conserve for

beneficial use 67,700 acre-feet of water annually that is seeping into the ground. It is anticipated that pre-construction activities will commence in 1995. The preferred alternative for the AAC Lining Project is the construction of a concrete-lined canal parallel to 23 miles of the existing AAC from the vicinity of Pilot Knob to Drop 3. Under a February 3, 1995 agreement with Imperial Irrigation District entitled "Agreement Relating to the Lining of the All American Canal", Metropolitan would provide the funding for implementation of the lining project, and be reimbursed if another California Contractor (Palo Verde Irrigation District, Imperial Irrigation District, or Coachella Valley Water District) uses the conserved water. The agreement has been transmitted to Palo Verde Irrigation District, Coachella Valley Water District, and Reclamation for their approval. It is estimated that 185,000 cubic yards of sand and gravel will be required for the concrete lining (85%) and gravel surfacing of roads (15%). The enclosed map shows the AAC Lining Project in relation to the proposed mining area.

Metropolitan requests that the Draft EIR include an analysis of the potential use of tailings from the proposed mining operation to meet the sand and gravel requirements of the AAC Lining Project. The analysis should include an assessment of the tailings' physical and chemical adequacy as an aggregate for concrete batching and assess the availability of transportation routes from the proposed mine to the AAC Lining Project area.

If the tailings could be made available for the AAC Lining Project in a feasible manner, it would alleviate the demand for other developed and undeveloped sand and gravel sources. Further, it may be possible that a portion of material excavated to construct the parallel canal could be used for reclamation of the mining site. Coordination of these activities would provide an opportunity for wise use of resources and an overall reduction of impacts to the environment.

We look forward to working with you and appreciate the opportunity to provide input to your planning process. If we can be of further assistance, please contact me at (213) 217-6242.

Very truly yours,

Laura J. Simonek

Laura J. Simonek
Senior Environmental Specialist

MME:arb

Enclosure

cc: Mr. Jesse P. Silva, P.E.
Imperial Irrigation District
P.O. Box 937
Imperial, California 92251

United States Department of the Interior

BUREAU OF MINES
Western Field Operations Center
East 360 3rd Avenue
Spokane, Washington 99202-1413

RECEIVED
MAY 15 1995
CHEMGOLD, INC.

May 10, 1995

FAXED
CHEMGOLD, INC
TO: DWIGHT CAREY, EMA
DATE: 5-16-95 TIME: 7:00 AM
NO.
FROM: CK MCARTHUR PAGES: 1

Mr. C. Kevin McArthur
Vice President & General Manager
CHEMGOLD, INC.
1891 Rail Avenue
Yuma, AZ 85365

Dear Mr. McArthur:

Thank you for the copy of your plan of operations and reclamation plan for the Imperial Project. We found the document to be straightforward and highly informative. The Bureau of Mines' only concern for this project centers on conservation of mineral resources. These concerns include:

1. The placement of temporary waste piles over potential resources may make these potential resources non-recoverable in the future.

2. Backfilling the pits would interfere with mining the resources in the mineralized potential area, and could also result in the loss of resources that are subeconomic at present.

3. The waste pile and heap leach pad are adjacent to the defined ore zone. Did condemnation drilling show any ore extending under the dump or leach pad?

4. Could subeconomic material be stockpiled for future use instead of placing it on a waste dump?

Thank you for the opportunity to review and comment on your plan. If you have any questions, please call me at (509) 353-2700. If you would like the Bureau of Mines to provide expertise in analyzing any particular aspect of this or any other Plan of Operation, please give us a call. We would welcome an opportunity to provide technical assistance to the BLM in this area.

Sincerely,

James Spear

James Spear, Mining Engineer
Branch of Engineering and Economic Analysis

To: Imperial County Planning Depr./Jesse Soriano

From: Edie Harmon, Imperial County Rep. Sierra Club San Diego Chapter

Re: Chemgold NOP for DEIR

Sierra Club appreciates the opportunity to comment on the NOP. However, because of time constraints, our list of concerns brief at this time.

Re the project description: Is it only 360 tons of waste to be mined? If so what is meant by the term waste, or over what period of time?

Comprehensive groundwater studies should be performed. Will groundwater be pumped from the project site or from a distant location? Is groundwater considered to be seepage and recharge from the Colorado River? What measures will be taken to protect underlying groundwater resources? What are performance standards and experience at other operations where liners and irrigation systems for leach heaps have been used? What measures will be taken to detoxify the leach heap piles after operations cease? Will pits be completely back-filled after operations cease? What will the project site look like after operations cease? What will be the impacts of operations on wildlife and the migration or foraging of wildlife? How will dust and other pollutants impact vegetation and the quality and quantity of forage and habitat for wildlife and birds? What are the safety factors related to visitor use of surrounding public lands for recreational purposes? How will operations affect the quality of wilderness experience in the nearby Wilderness Area? How will the operations impact existing routes of travel in the area? What are the ultimate future uses of the site? What are the details of storm drainage, flood control, groundwater protection, and revegetation/reclamation plans?

Please send copies of the Draft EIR/EIS and all technical appendices for our review when they are available. Thank you in advance for keeping the Sierra Club advised of dates for future public hearings and for providing copies of the Draft EIR/EIS.

Post-it® Fax Note 7671	Date 5/9/95	# of pages ▶ 1
To Eric Mintz	From Jesse Soriano	
Co./Dept. Allen & Ema	Co.	
Phone #	Phone # 339-4239	
Fax # 714-529-8943	Fax #	

RECEIVED
MAY 08 1995
IMPERIAL COUNTY
BUILDING INSPECTION

ENVIRONMENTAL MANAGEMENT ASSOCIATES

MEMORANDUM

TO: Keith Shone - Bureau of Land Management
Jesse Soriano - Imperial County Planning Department (ICPD)
C. Kevin McArthur - Chemgold, Inc.

FROM: Dwight L. Carey/Eric R. Mintz

SUBJECT: Chemgold Imperial Project EIS/EIR - Discussion of Notice of Intent/Notice of Preparation Comment Documents Received

DATE: May 24, 1995

Listed below in chronological order are the comments which EMA has received to the BLM Notice of Intent to Prepare an Environmental Impact Statement (EIS) and the ICPD Notice of Preparation to Prepare an Environmental Impact Report (EIR), as well as the comments received at the public scoping meetings conducted by the BLM. Copies of each of these comments are attached. Pursuant to Task 11 of the Chemgold Imperial Project EIS/EIR Preparation Plan, EMA has evaluated these comments and provides the following discussion of these comments:

1. David F. Farrel, Chief, Office of Federal Activities, U.S. Environmental Protection Agency. April 5, 1995.

   All comments will be addressed, as applicable to the project, to the appropriate level in the EIS/EIR.

2. John F. Merrell, Planning Director, Yuma County, Arizona - Development Services Department. April 14, 1995.

   The EIR/EIS will include an analysis of project impacts, both positive and negative, to recreational opportunities and other socioeconomic effects for Yuma County residents.

3. Roger Henning, Palo Verde Irrigation District. April 17, 1995.

   No action necessary.

4. Jim Wilson, Laser, Inc.. April 17, 1995.

   The Laser, Inc. comments appear to have been written specifically for a mining operation located in the Humboldt River drainage of northern Nevada. Since the specific environmental conditions of this area of Nevada are very different than

those of southeastern California, many of the Laser, Inc. comments are not relevant to the Imperial Project. However, a few of the Laser, Inc. comments are general enough to be partially applicable to the Imperial Project, and these are addressed as follows:

a. The cumulative Impacts Chapter of the EIS/EIR will discuss the potential cumulative impacts of all projects, existing and proposed in the area.

b. Most of the applicable requested information regarding the project will be included in the Proposed Action Chapter of the EIS/EIR, although some of the applicable requested project information will be included in the Affected Environment and Environmental Consequences Chapters of the EIS/EIR.

c. The existing air quality, impacts to air quality from construction and operation of the proposed project, and cumulative impact to air quality in the general area of the project will be addressed to the appropriate level in the applicable sections of the Affected Environment, Environmental Consequences, and Cumulative Impacts Chapters of the EIS/EIR.

d. The quantities of petroleum hydrocarbons stored and consumed on-site will be provided in the Proposed Action Chapter of the EIS/EIR.

e. The Environmental Consequences Chapter of the EIS/EIR will contain an inventory of criteria air pollutant and cyanide emissions. Ambient air quality modelling, or detailed OSHA evaluations, are not intended to be conducted.

f. Air pollutant control requirements, as established by the Imperial County Air Pollution Control District, will be discussed in the EIS/EIR.

g. The existing water quality, impacts to water quality from the proposed project, and cumulative impact to water quality in the general area will be addressed to the appropriate degree in the applicable sections of the Affected Environment, Environmental Consequences, and Cumulative Impacts Chapters of the EIS/EIR.

h. The existing groundwater conditions, impacts to groundwater from the proposed project, and cumulative impacts to groundwater in the general area will be addressed to the appropriate degree in the applicable sections of the Affected Environment, Environmental Consequences and Cumulative Impacts Chapters of the EIS/EIR.

i. Heap leach facility design, construction, and mining requirements are all regulated by the California Regional Water Quality Control Board - Colorado River Basin Region, as part of its waste discharge requirements permit process. The EIS/EIR will discuss the Imperial Project's proposed construction and operating techniques, and the Board's regulatory requirements, as appropriate.

j. Information regarding the effects of the project on wildlife will be included as appropriate in the Affected Environment and Environmental Consequences Chapters of the EIS/EIR.

k. A survey of soils in the project area will be conducted and an analysis of viability for reclamation included in the EIS/EIR.

5. T.A. Manfredi, Community Planner - United States Marine Corps Air Station, Yuma. April 18, 1995.

It would appear appropriate to follow up with the USMC suggestion to discuss the identified concerns of the USMC before evaluating them. EMA suggests that EMA and Chemgold, and the BLM and ICPBD, if desired, meet with the appropriate representatives of the Yuma Air Station to discuss the concerns of the USMC.

6. Rusty McBride/Carol Sassie - California Department of Fish and Game. Public Scoping Meeting of April 18, 1995.

EMA recommends providing these members of the CDFG field staff with copies of the completed biological survey and coordinating a field visit to discuss these and other issues specific to the project, as discussed during the project scoping meeting held in Yuma.

7. Larry Todd - Mesquite Mine. Public Scoping Meeting of April 18, 1995.

The existing socioeconomic setting and projected impacts to the socioeconomic environment, both positive and negative, will be discussed in the Affected Environment, Environmental Consequences, and Mitigation Measures sections of the EIS/EIR.

8. Ed Kirwan - American Girl Mining Joint Venture. Public Scoping Meeting of April 18, 1995.

No action necessary.

9. Steve Baumann. Public Scoping Meeting of April 18, 1995 and April 19, 1995.

The existing socioeconomic setting and projected impacts to the socioeconomic environment, both positive and negative, will be discussed in the Affected Environment, Environmental Consequences, and Mitigation Measures sections of the EIS/EIR.

10. James S. Pompy, Manager - Reclamation Unit, State of California Department of Conservation - Office of Mine Reclamation. April 24, 1995.

a. The reclamation plan is part of the Proposed Action and, therefore, the environmental consequences of the Proposed Action, including implementation of the reclamation plan, will be discussed and appropriate mitigation measures developed and included in the EIS/EIR.

b. The reclamation plan will include a geotechnical analysis which assesses the long-term stability issues associated with the proposed pit slopes.

c. A revegetation plan will be part of the reclamation plan, which will incorporate Chemgold test plot activities at their nearby Picacho Mine. Stockpiling of top soil, minimization of surface disturbance, and selection of seed mixes are all part of the reclamation plan.

d. The EIR/EIS will address both water resource- and water-quality related issues of the project in the appropriate sections. A hydrogeologic analysis will be prepared to assess the availability of, and impacts to, groundwater from project consumptive uses; this report will be included as an appendix to the EIS/EIR and summarized in the appropriate sections of the EIS/EIR.

e. A biological survey of the subject property has been prepared; this report will be included as an appendix to the EIS/EIR and summarized in the appropriate sections of the EIS/EIR. Consultation with both the CDFG and USFWS will be conducted in parallel with the preparation of the EIS/EIR, and the results of this consultation summarized in the EIS/EIR.

11. Bill Dillon, Chief - Planning Studies Branch, State of California Department of Transportation. April 28, 1995.

The EIS/EIR will address the issue of projected daily truck use on the local roadway network in the Environmental Consequences section.

12. Patricia Wolf, Acting Regional Manager, Region 5 - State of California Department of Fish and Game. May 8, 1995.

    The CDFG comments are generic, and not specific to the Imperial Project. However, to the extent applicable, the EIS/EIR will address each of the CDFG comments to the level appropriate. EMA recommends providing CDFG field staff with copies of the completed biological survey and coordinating a field visit to discuss issues specific to the project, as discussed during the project scoping meeting held in Yuma.

13. Tom Levy, General Manager/Chief Engineer - Coachella Valley Water District. May 12, 1995.

    No action necessary.

14. Laura J. Simonek, Senior Environmental Specialist - Metropolitan Water District of Southern California. May 16, 1995.

    The EIS/EIR will include analyses of the chemical characteristics of mined waste rock. Should Chemgold and the MWD determine that waste rock could be used for the All American Canal Lining Project, a determination will need to be made by the BLM and ICPD regarding how, if at all, this activity should be evaluated in the Imperial Project EIS/EIR, or in a separate NEPA/CEQA analysis. EMA would probably recommend that a NEPA/CEQA analysis of this activity be conducted separately.

15. James Spear, Mining Engineer - USDI, Bureau of Mines. May 19, 1995.

    The concerns raised by the Bureau of Mines regarding the conservation of mineral resources will be addressed in the appropriate sections of the EIS/EIR.

16. Edie Harmon, Imperial County Representative of the Sierra Club - San Diego Chapter. No date.

    All issues mentioned in Ms. Harmon's letter will be answered in detail in the appropriate sections of the EIS/EIR.

APPENDIX C-1 - CHEMGOLD, INC. IMPERIAL PROJECT WASTE CHARACTERIZATION STUDY

CHEMGOLD, INC. IMPERIAL PROJECT
IMPERIAL COUNTY, CALIFORNIA

WASTE CHARACTERIZATION STUDY

EMA Report No. 0959-03
December 1995

Prepared for:

Chemgold, Inc.
P.O. Box 758
Winterhaven, California 92283

CHEMGOLD, INC. IMPERIAL PROJECT
IMPERIAL COUNTY, CALIFORNIA

WASTE CHARACTERIZATION STUDY

EMA Report No. 0959-03
December 1995

Prepared for:

Chemgold, Inc.
P.O. Box 758
Winterhaven, California 92283

LIMITATIONS

This report was prepared by Environmental Management Associates, Inc. (EMA) in conformance with the scope of work prescribed by our CLIENT. The work has been conducted in an objective and unbiased manner and in accord with generally accepted professional practice for this type of work. No other warranty, either expressed or implied, is made as to the findings, recommendations, specifications or opinions presented herein.

ENVIRONMENTAL MANAGEMENT ASSOCIATES, INC.

Kent S. Samuelson
Senior Geologist

Richard F. DeLong,
Principal Geologist

Dwight L. Carey, D.Env., CEM-1118
Principal

Corporate Office:
1698 Greenbriar Lane, Suite 210, Brea, California 92621
(714) 529-3695 FAX: (714) 529-8543

Regional Office:
100 W. Grove St., Suite 100, Reno, Nevada 89509
(702) 828-3939 FAX: (702) 828-3940

EMA

CHEMGOLD, INC. IMPERIAL PROJECT
IMPERIAL COUNTY, CALIFORNIA

WASTE CHARACTERIZATION STUDY

TABLE OF CONTENTS

Page

LIMITATIONS i

1. INTRODUCTION 1

2. Analytical Methods 1
   2.1. Acid Neutralization Potential 1
   2.2. Chemical Characteristics of Waste Rock Materials and Leachate 2

3. IMPERIAL PROJECT WASTE STREAMS 2
   3.1. Source of Waste 2
   3.2. Descriptions of the Wastes 3

4. SAMPLE COLLECTION 4

5. SAMPLE RESULTS 6
   5.1. Sample Preparation 6
   5.2. Acid Neutralization Potential Results 6
   5.3. Chemical Characteristics of Waste Rock and Leachate 6
   5.4. Chemical Characteristics of Spent Ore and Leachate 7

6. CONCLUSIONS 8

7. REFERENCES 8

LIST OF TABLES

Page

Table 1: Summary of Samples Collected 5
Table 2: Acid Neutralization Potential of Ore and Waste Rock 7
Table 3: Chemical Characteristics of the Waste Rock and Leachate 9
Table 4: Chemical Characteristics of the Spent Ore and Leachate 10

APPENDICES

APPENDIX A - Analytical Results

CHEMGOLD, INC. IMPERIAL PROJECT
IMPERIAL COUNTY, CALIFORNIA

WASTE CHARACTERIZATION STUDY

1. INTRODUCTION

This report presents the results of a study to determine the acid generation potential (AGP), the acid neutralization potential (ANP), and the chemical characteristics of potential leachate generated from contact with waste rock and leached ore material which may be produced by the proposed Chemgold, Inc. (Chemgold) Imperial Project. This information is necessary to classify the waste to be generated with respect to the standards presented in Title 23, Chapter 15, Article 7 of the California Code of Regulations so that the material may be properly managed following closure of the project.

2. Analytical Methods

2.1. Acid Neutralization Potential

Some types of waste rock and spent ore can generate mineral acids upon exposure to water and the atmosphere (which is described as a material's "acid generating potential"), while other types may be acid neutralizing (which is described as a material's neutralization potential). Generally, rock with a high acid generating potential contains a sufficient quantity of sulfide minerals, which can react with water and atmospheric oxygen to produce sulfuric acid. The generated acid may then leach potentially toxic metals from the waste materials. Rock with low acid and high neutralizing potentials are generally environmentally benign.

The procedures used to predict the AGP reported herein generally conform with methods outlined in the California Mining Association's publication *Mine Waste Management* (1992), a highly regarded resource document on mine waste characterization and management. The prediction of AGP begins with obtaining materials which "... represent the worst-case, or the maximum, AGP. As the evaluation program evolves, the objective of the subsequent sampling programs would be to obtain representative samples from a range of geochemical groups within each of the lithologic units to be affected by mine development" (California Mining Association, 1992, p. 166).

Following sample collection, analytical testing is then performed to determine pH (using the saturated paste method) and to determine AGP consistent with the approach proposed by Smith and Barton-Bridges (1991), which includes the use of static and kinetic tests (if deemed necessary) in a three (3)-stage process:

- Stage 1: Both the acid potential (AP), using total sulfur (LECO furnace method), and the acid neutralization potential (NP) are determined. Both results are converted to common units and the ratio of NP to AP is calculated. If the NP/AP ratio is greater than 3, the waste is considered to be non-acid generating. If the NP/AP ratio is less than 3, Stage 2 testing should be conducted.

- Stage 2: The forms of sulfur in the waste rock, in particular the sulfide sulfur, is determined. The AP is recalculated on the basis of the sulfide sulfur values, and then the NP/AP ratio is recalculated. If the NP/AP ratio does not exceed 3, the waste may be acid generating, and Stage 3 testing should be conducted.

- Stage 3: A kinetic test using a humidity cell or column/lysimeter is performed. Concentrations of all leachable species of interest are determined on leach samples, plus those of potential products of acid generation.

2.2. Chemical Characteristics of Waste Rock Materials and Leachate

To determine chemical characteristics of the waste rock and leached ore, total metal concentrations (using the applicable approved acid digestion and analytical techniques) for the seventeen (17) Total Threshold Limit Concentration (TTLC) metals are analyzed. To determine chemical characteristics of the leachate which could be generated under proposed conditions from the waste rock and leached ore, metals concentrations in a laboratory-generated leachate (using the U.S. Environmental Protection Agency (EPA) Method 1312 Synthetic Precipitation Leaching Procedure (SPLP)) for the seventeen (17) TTLC metals are analyzed. The SPLP uses a laboratory-prepared "synthetic" acidic rainfall "to determine the mobility of both of organic and inorganic analytes present in samples of soils and wastes" which may be exposed to natural weathering processes. This differs from the extraction solutions used in the California WET or EPA Toxicity Concentration Leaching Procedure (TCLP) (EPA Method 1311), which each use organic acids typical of those found in municipal waste landfills.

3. IMPERIAL PROJECT WASTE STREAMS

3.1. Source of Waste

The mining waste to be generated from the proposed Imperial Project would consist of the following: (1) sub ore-grade waste rock removed during mining; and (2) spent ore remaining on the heap leach pad after precious metals have been

extracted through a cyanide leaching process and the leached ore has been rinsed to reduce residual cyanide concentrations to levels consistent with California Regional Water Quality Control Board - Colorado River Basin Region (CRWQCB-CRBR) guidelines. The source of the ore and waste rock would be the material mined from the proposed co-joining West, Singer, and East Pits.

3.2. Descriptions of the Wastes

Variations in the chemical characteristics of the waste generated by the Imperial Project would be dependent upon: (1) the different rock types mined; and (2) whether the mined material is waste rock or ore-grade material. The Imperial Project ore bodies and associated waste rock material are comprised of two (2) main rock types: biotite gneiss and sericitic gneiss. Two (2) additional waste rock types will be encountered during mining: Tertiary volcanic rocks and Quaternary gravel deposits. All of these materials are more fully described as follows:

Biotite Gneiss: The biotite gneiss units range mineralogically from hornblende-biotite to quartz feldspathic gneiss rock types with irregular zones of biotite-chlorite gneiss. Local gradational sequences of the biotite gneiss develop into a schistose equivalent within this unit. Mineralized biotite gneiss is typically brecciated and contains hematite and limonite zones which are alteration products of the biotite and pyrite. Veinlets of mineralized hematite and calcite are common. Little or no sulfide minerals have been observed in the drill cuttings or core during sampling. Remnants of pyrite have been observed, but as hematitic pseudomorphs.

Sericitic Gneiss: Sericitic gneiss is the predominant rock type in the East Pit area. Units vary from quartz- and feldspar-rich muscovite gneiss to sericitic gneiss. Quartz muscovite gneiss and gradational quartz feldspathic gneiss occur as schistose equivalents. Mineralized sericitic gneiss is typically fractured, consisting of hematite-altered biotite-chlorite gneisses and schists. Quartz veinlets, and sericitic and hematitic gouge zones, also occur within the mineralized units.

Quaternary Gravel: The gravel units consist of mixed amounts of gneiss and volcanic rock deposited as fanglomerate layers. Gravel textures vary from granular to pebble-size subangular clasts in a fine-grained sand/silt matrix. Matrix cement consists of calcium carbonate. Cementation varies from poor to moderate. Cobble to boulder-size gravel also occurs as thin, discontinuous units. Gneissic clasts (composing approximately 75 percent of the gravel) consist of variations of hornblende-biotite to quartz-feldspathic gneiss.

Volcanic clasts (composing approximately 25 percent of the gravel) are typically dark, maroon-colored, fine-grained andesite and basalt fragments.

Tertiary Volcanic Rocks: The volcanic units consist of basalt to andesite flows which unconformably overlie the metamorphic units. Core specimens display massive and brecciated textures cemented with calcium carbonate.

Unaltered rock of each of these rock types will comprise the majority of the waste rock from the Imperial Project. Altered and mineralized biotite gneiss and sericitic gneiss will comprise the majority of the heap leach pad material prior to leaching. Based on observations made during sampling, all ore-grade and waste rock materials occur in an oxidized state.

4. SAMPLE COLLECTION

Twenty-three (23) representative samples of the various rock types described in Section 3.2 were collected by Chemgold personnel. A description of each of these samples is presented in Table 1. The samples consisted of reverse circulation (RC) drill cuttings composited at select intervals for isolating specific rock types and geochemical groups, as necessary. Because of the consistent nature of the deposit, rock units in the proposed central Singer Pit are considered equivalent to those of both the East Pit and West Pit and, therefore, no separate samples of the Singer mineralized zone were collected.

All Imperial Project lithologic units to be mined have been determined to be in an oxidized state. Thus, there are no rock units within the Project mine and process area known to contain significant sulfide minerals, and no units which would represent a worst-case scenario regarding maximum AGP. Therefore, representative sampling of each identified lithologic unit was determined to be the definitive sampling program for predicting ANP.

Table 1: Summary of Samples Collected

Sample Number	Sample Date	Sample Location	Sample Elevations[1]	Rock Type	Grade	Oxidation State
WP-1	10-11-94	West Pit	427 535 615	Biotite Gneiss	Ore	Oxidized
WP-2	10-11-94	West Pit	357 435 670	Biotite Gneiss	Ore	Oxidized
WP-3	10-11-94	West Pit	470 587	Biotite Gneiss	Waste	Oxidized
WP-4	10-11-94	West Pit	770	Volcanics	Waste	Oxidized
WP-5	10-11-94	West Pit	496 681	Gravel	Waste	Oxidized
WP-6	2-17-95	West Pit	-98	Biotite Gneiss	Ore	Oxidized
WP-7	2-17-95	West Pit	163	Biotite Gneiss	Waste	Oxidized
WP-8	2-17-95	West Pit	7	Biotite Gneiss	Ore	Oxidized
WP-9	2-17-95	West Pit	45	Gravel	Waste	Oxidized
EP-1	10-11-94	East Pit	575 617	Sericitic Gneiss	Ore	Oxidized
EP-2	10-11-94	East Pit	547	Sericitic Gneiss	Ore	Oxidized
EP-3	10-11-94	East Pit	452 477	Biotite Gneiss	Ore	Oxidized
EP-4	10-11-94	East Pit	420 507	Biotite Gneiss	Ore	Oxidized
EP-5	10-11-94	East Pit	561 687	Sericitic Gneiss	Waste	Oxidized
EP-6	10-11-94	East Pit	434 527	Biotite Gneiss	Waste	Oxidized
EP-7	10-11-94	East Pit	594	Volcanics	Waste	Oxidized
EP-8	10-11-94	East Pit	605 641	Gravel	Waste	Oxidized
EP-9	2-17-95	East Pit	110	Biotite Gneiss	Ore	Oxidized
EP-10	2-17-95	East Pit	-10	Biotite Gneiss	Waste	Oxidized
EP-11	2-17-95	East Pit	59	Biotite Gneiss	Ore	Oxidized
EP-12	2-17-95	East Pit	-1	Biotite Gneiss	Waste	Oxidized
EP-13	2-17-95	East Pit	682 692	Sericitic Gneiss	Waste	Oxidized
EP-14	2-17-95	East Pit	556 566	Sericitic Gneiss	Waste	Oxidized

[1] - Units are in feet above mean sea level. Multiple elevations represent sample elevations of a composite sample.

5. SAMPLE RESULTS

5.1. Sample Preparation

Each ore sample was processed with cyanide solution using a standard bottle roll procedure, then rinsed to reduce residual cyanide concentrations to simulate the rinsed leached ore for the waste characterization analyses. Waste rock was not leached or rinsed. Standard 2-millimeter particle size samples of the spent ore were used for the chemical characteristics analyses.

5.2. Acid Neutralization Potential Results

Table 2 presents the results of the pH and acid neutralization potential analyses of the waste rock and ore. All of the analyzed samples exhibited a pH of 8.75 or greater and, with one (1) exception, high ANP values. Sample EP-5 has a Stage 1 ANP of 2.4 using the total sulfur value. In accordance with the Smith and Barton-Bridges procedure (see Section 2.1), the Stage 2 procedure (AP considering only sulfide sulfur) was conducted for sample EP-5. Using only sulfide sulfur for calculating the AP, the resulting ANP is 4.0. Samples EP-13 and EP-14, acquired from the same drill hole as EP-5, represent material that exists directly above and below the interval from which sample EP-5 was taken. The total sulfur ANP values for these two (2) samples are 13.5 and 23, respectively. These values support the indication that the relatively low total sulfur ANP value for EP-5 is anomalous.

5.3. Chemical Characteristics of Waste Rock and Leachate

Table 3 presents the results of the analyses conducted to determine the chemical characteristics of the waste rock, and the leachate which may result from exposure of the waste rock to acidic rainfall. Total metal concentrations were, in all cases, an order of magnitude or more below the corresponding metal TTLC. Metal concentrations from the SPLP leachate were all very low.

Table 2: Acid Neutralization Potential of Ore and Waste Rock

SAMPLE NUMBER	SAMPLE LOCATION	pH	TOTAL SULFUR (percent)	ACID POTENTIAL	NEUTRALIZATION POTENTIAL	ACID NEUTRALIZATION POTENTIAL
Ore						
WP-1	West Pit	9.72	0.002	<0.1	79	>790.00
WP-2	West Pit	9.45	0.008	0.2	116	580.00
WP-6	West Pit	9.72	0.008	0.2	94	470.00
WP-8	West Pit	9.81	0.006	0.2	6.6	33.00
EP-1	East Pit	9.85	0.026	0.8	5.4	6.75
EP-2	East Pit	9.66	0.052	1.6	8.4	5.25
EP-3	East Pit	10.27	0.014	0.4	9.4	23.50
EP-4	East Pit	10.24	0.048	1.5	6.0	4.00
EP-9	East Pit	9.53	0.002	<0.1	116	>1,160.00
EP-11	East Pit	9.68	0.002	1.8	23	12.78
Waste Rock						
WP-3	West Pit	9.54	0.002	<0.1	79	>790.00
WP-4	West Pit	8.75	0.004	0.1	69	690.00
WP-7	West Pit	8.96	0.006	0.2	17.5	87.50
EP-5	East Pit	9.65	0.016	0.5	1.2	[1]2.40
EP-6	East Pit	9.43	0.032	1.0	27	27.00
EP-7	East Pit	8.75	0.008	0.2	76	380.00
EP-10	East Pit	9.22	0.004	0.1	27	270.00
EP-12	East Pit	9.36	0.006	<0.1	13	>130.00
EP-13	East Pit	9.03	0.008	0.2	2.7	13.50
EP-14	East Pit	9.01	0.058	0.2	4.6	23.00
Cemented Gravels						
WP-5	West Pit	9.21	0.030	0.9	34	37.78
WP-9	West Pit	9.61	0.004	0.1	17.5	175.00
EP-8	East Pit	9.09	0.010	0.3	39	130.00

[1] - Sample EP-5 has a sulfide sulfur Acid Neutralization Potential of 4.0.

5.4. Chemical Characteristics of Spent Ore and Leachate

Table 4 presents the results of the analyses conducted to determine the chemical characteristics of the spent ore, and the leachate which may result from exposure of the spent ore to acidic rainfall. Total metal concentrations were in all

cases an order of magnitude or more below the corresponding metal TTLC. Metal concentrations from the SPLP leachate were all very low.

6. CONCLUSIONS

All sampled Imperial Project waste rock and spent ore materials have an ANP greater than 3, which indicates that the material can be properly classified as non-acid generating waste. Total metal concentrations for both the waste rock and spent ore were in all cases an order of magnitude or more below the corresponding metal TTLC, indicating that the wastes can be properly classified as Group C mining wastes in accordance with Title 23, Chapter 15, Section 2571(b)(3) of the California Code of Regulations (CCR).

7. REFERENCES

California Mining Association. *Mine Waste Management: A Resource for Mining Industry Professionals, Regulators and Consulting Engineers*. Lewis Publishers, Inc., 1992.

Smith, Adrian and J.B. Barton-Bridges. *Some Considerations in the Prediction and Control of Acid Mine Drainage Impact on Groundwater From Mining in North America.* Proceedings EPPIC Conference, Johannesburg, South Africa. May 1991.

Table 3: Chemical Characteristics of the Waste Rock and Leachate

Sample	Ag	As	Ba	Be	Cd	Co	Cr	Cu	Hg	Mo	Ni	Pb	Sb	Se	Tl	V	Zn
TOTAL METAL ANALYSES (parts per million equivalent)																	
TTLC	500	500	10,000	75	100	8,000	2,500	2,500	20	3,500	2,000	1,000	500	100	700	2,400	5,000
WP-3	<1	5.9	81	0.9	<0.5	20	33	68	0.3	<5	23	12	<5	<0.2	<5	74	153
WP-4	<1	0.6	153	1.5	<0.5	20	89	32	<0.2	<5	54	16	<5	<0.2	12	46	153
WP-5	<1	18	29	0.4	<0.5	7.9	7.9	9.6	<0.2	<5	7.4	5.5	<5	<0.2	5.3	25	55
WP-7	<1	6.2	9.3	0.91	<0.5	12	<2.5	17	<0.2	<5	<2	36	<5	<0.2	<5	1	85
WP-9	<1	22	17	1.3	<0.5	17	4.8	2.4	<0.2	<5	3	14	<5	<0.2	<5	33	38
EP-5	<1	3.1	14	<0.5	<0.5	4.9	<2.5	107	0.2	7.9	4.3	20	<5	<0.2	<5	29	69
EP-6	<1	6.9	23	<0.5	<0.5	4.0	<2.5	42	0.3	<5	4.0	16	<5	<0.2	10	23	55
EP-7	<1	5.0	137	0.9	<0.5	11	29	15	0.2	<5	26	10	<5	<0.2	<5	44	72
EP-8	<1	3.5	44	<0.5	<0.5	6.6	8.4	31	0.2	<5	8.9	9.1	<5	<0.2	<5	30	105
EP-10	1.3	0.5	14	1.0	<0.5	14	4.9	5.3	<0.2	<5	2.1	29	<5	<0.2	<5	23	120
EP-12	1.4	1.7	6.1	1.0	<0.5	15	6.0	12	<0.2	<5	4.3	14	<5	<0.2	<5	11	54
SYNTHETIC PRECIPITATION LEACHING PROCEDURE (EPA METHOD 1312) ANALYSES (parts per million equivalent)																	
WP-3	<0.02	0.019	0.81	<0.01	<0.01	<0.02	<0.05	0.03	<0.0005	<0.1	<0.04	<0.05	0.2	<0.001	<0.1	<0.1	0.35
WP-4	<0.02	0.012	0.76	<0.01	<0.01	<0.02	<0.05	<0.02	<0.0005	<0.1	<0.04	<0.05	0.6	<0.001	<0.1	<0.1	0.32
WP-5	<0.02	0.011	1.1	<0.01	<0.01	<0.02	<0.05	0.02	<0.0005	<0.1	<0.04	<0.05	0.3	<0.001	<0.1	<0.1	0.50
WP-7	<0.02	<0.005	0.78	0.03	<0.01	<0.02	<0.05	<0.02	<0.0005	<0.1	<0.04	<0.05	<0.1	<0.001	<0.1	<0.1	0.04
WP-9	<0.02	<0.005	0.43	0.03	<0.01	<0.02	<0.05	<0.02	<0.0005	<0.1	<0.04	<0.05	<0.1	<0.001	<0.1	<0.1	0.02
EP-5	<0.02	0.017	0.49	<0.01	<0.01	<0.02	<0.05	<0.02	<0.0005	<0.1	<0.04	<0.05	0.3	<0.001	<0.1	<0.1	0.26
EP-6	<0.02	0.013	0.75	<0.01	<0.01	<0.02	<0.05	0.02	<0.0005	<0.1	<0.04	<0.05	1.1	0.001	<0.1	<0.1	0.32
EP-7	<0.02	0.035	2.1	<0.01	<0.01	<0.02	<0.05	0.04	<0.0005	<0.1	<0.04	<0.05	<0.1	<0.001	<0.2	<0.1	0.83
EP-8	<0.02	0.010	0.71	<0.01	<0.01	<0.02	<0.05	<0.02	<0.0005	<0.1	<0.04	<0.05	<0.1	<0.001	<0.1	<0.1	0.34
EP-10	<0.02	<0.005	0.55	0.03	<0.01	<0.02	<0.05	<0.02	<0.0005	<0.1	<0.04	<0.05	<0.1	<0.001	<0.1	<0.1	0.02
EP-12	<0.02	<0.005	0.76	0.03	<0.01	<0.02	<0.05	<0.02	<0.0005	<0.1	<0.04	<0.05	<0.1	<0.001	<0.1	<0.1	0.04

Table 4: Chemical Characteristics of the Spent Ore and Leachate

Sample	Ag	As	Ba	Be	Cd	Co	Cr	Cu	Hg	Mo	Ni	Pb	Sb	Se	Tl	V	Zn
TOTAL METAL ANALYSES (parts per million equivalent)																	
TTLC	500	500	10,000	75	100	8,000	2,500	2,500	20	3,500	2,000	1,000	500	100	700	2,400	5,000
WP-1	<1	21	13	<0.5	<0.5	7.5	<2.5	25	0.6	<5	5.5	41	<5	<0.2	<5	42	128
WP-2	<1	18	20	0.5	<0.5	7.3	<2.5	192	0.7	<5	5.3	14	<5	0.4	<5	35	70
WP-6	<1	24	21	1.8	<0.5	25	3.7	10	<0.2	<5	3.4	25	<5	<0.2	<5	52	85
WP-8	<1	36	15	1.6	<0.5	22	3.1	20	<0.2	<5	2.2	76	<5	<0.2	<5	25	200
EP-1	<1	7.2	10	<0.5	<0.5	1.9	<2.5	24	0.2	<5	<2	9.0	<5	<0.2	<5	14	18
EP-2	<1	7.6	25	<0.5	<0.5	4.1	<2.5	32	<0.2	5	3.7	8.4	<5	0.4	<5	19	44
EP-3	19	4.8	44	1.3	<0.5	36	5.5	78	0.8	<5	25	31	<5	0.2	<5	77	342
EP-4	<1	3.0	20	<0.5	<0.5	2.9	3.7	20	0.4	6.6	28	14	<5	<0.2	7.1	18	36
EP-9	<1	12	8.6	2.3	<0.5	36	4.8	13	<0.2	<5	9.1	49	<5	<0.2	<5	58	78
EP-11	<1	3.4	37	1.5	<0.5	22	8.6	57	<0.2	<5	7.1	5.4	<5	0.5	<5	25	330
SYNTHETIC PRECIPITATION LEACHING PROCEDURE (EPA METHOD 1312) ANALYSES (parts per million equivalent)																	
WP-1	<0.02	0.040	1.1	<0.01	<0.01	<0.02	<0.05	<0.02	<0.0005	<0.1	<0.04	<0.05	0.5	<0.001	<0.1	<0.1	0.44
WP-2	<0.02	0.022	0.73	<0.01	<0.01	<0.02	<0.05	0.04	<0.0005	<0.1	<0.04	<0.05	<0.1	<0.001	<0.1	<0.1	0.40
WP-6	<0.02	0.017	0.78	0.03	<0.01	<0.02	<0.05	<0.02	0.0006	<0.1	<0.04	<0.05	<0.1	<0.001	<0.1	<0.1	0.04
WP-8	<0.02	0.017	0.72	0.03	<0.01	0.02	<0.05	<0.02	0.0005	<0.1	<0.04	<0.05	<0.1	<0.001	<0.1	<0.1	0.04
EP-1	<0.02	0.018	1.4	<0.01	<0.01	<0.02	<0.05	0.03	<0.0005	<0.1	<0.04	<0.05	<0.1	<0.001	<0.1	<0.1	0.46
EP-2	<0.02	0.008	0.97	<0.01	<0.01	<0.02	<0.05	<0.02	<0.0005	<0.1	<0.04	<0.05	<0.1	<0.001	<0.1	<0.1	0.37
EP-3	<0.02	0.012	1.2	<0.01	<0.01	<0.02	<0.05	<0.02	<0.0005	<0.1	<0.04	<0.05	0.2	<0.001	<0.1	<0.1	0.45
EP-4	<0.02	0.013	1.4	<0.01	<0.01	<0.02	<0.05	0.05	<0.0005	<0.1	<0.04	<0.05	0.5	<0.001	<0.1	<0.1	0.67
EP-9	<0.02	<0.005	0.92	0.03	<0.01	<0.02	<0.05	0.03	<0.0005	<0.1	<0.04	<0.05	<0.1	<0.001	<0.1	<0.1	0.04
EP-11	<0.02	<0.005	0.89	0.03	<0.01	<0.02	<0.05	<0.02	<0.0005	<0.1	<0.04	<0.05	<0.1	<0.001	<0.1	<0.1	0.16

APPENDIX A

Analytical Results

The information otherwise contained in this
Appendix/Attachment has been deleted from the
Draft Environmental Impact Statement/Environmental Impact Report (DEIS/EIR).

This deleted information can be found in its entirety at the
Bureau of Land Management
El Centro Resource Area Office

APPENDIX C-2 - SUPPLEMENT TO CHEMGOLD, INC. IMPERIAL PROJECT WASTE CHARACTERIZATION STUDY

CHEMGOLD, INC. IMPERIAL PROJECT
IMPERIAL COUNTY, CALIFORNIA

SUPPLEMENTAL WASTE CHARACTERIZATION STUDY

EMA Report No. 1093-01
September 1996

Prepared for:

Chemgold, Inc.
P.O. Box 758
Winterhaven, California 92283

CHEMGOLD, INC. IMPERIAL PROJECT
IMPERIAL COUNTY, CALIFORNIA

SUPPLEMENTAL WASTE CHARACTERIZATION STUDY

EMA Report No. 1093-02
September 1996

Prepared for:

Chemgold, Inc.
P.O. Box 758
Winterhaven, California 92283

LIMITATIONS

This report was prepared by Environmental Management Associates, Inc. (EMA) in conformance with the scope of work prescribed by our CLIENT. The work has been conducted in an objective and unbiased manner and in accord with generally accepted professional practice for this type of work. No other warranty, either expressed or implied, is made as to the findings, recommendations, specifications or opinions presented herein.

ENVIRONMENTAL MANAGEMENT ASSOCIATES, INC.

Daniel J. Davis, R.G.
Senior Geochemist

Dwight L. Carey, D.Env.
Principal

Corporate Office:
1698 Greenbriar Lane, Suite 210, Brea, California 92821-5919
(714) 529-3695 FAX: (714) 529-8543

Regional Office:
100 West Grove Street, Suite 100, Reno, Nevada 89509-4026
(702) 828-3939 FAX: (702) 828-3940

CHEMGOLD, INC. IMPERIAL PROJECT
IMPERIAL COUNTY, CALIFORNIA

SUPPLEMENTAL WASTE CHARACTERIZATION STUDY

TABLE OF CONTENTS

Page

LIMITATIONS i

LIST OF FIGURES iii

LIST OF TABLES iii

LIST OF APPENDICES iii

1. INTRODUCTION 1

2. OBJECTIVE 1

3. LITHOLOGIES AND SAMPLING METHODS 2

4. GEOCHEMICAL TESTING PROCEDURES 4
   - 4.1. Whole Rock Analyses 4
   - 4.2. Static Test Methods 5
   - 4.3. USEPA Method 1312 - Synthetic Precipitation Leach Test 6
   - 4.4. USEPA Method 1320 - Multiple Extraction Procedure 6

5. ANALYTICAL RESULTS 6
   - 5.1. Whole Rock Analytical Results 7
   - 5.2. Static Test Results 7
   - 5.3. USEPA Method 1312 Analytical Results 7
   - 5.4. USEPA Method 1320 Analytical Results 8

6. GEOCHEMICAL MODELING 9
   - 6.1. Equilibration of Inflowing Ground Water with Backfill Material 9
   - 6.2. Equilibration of USEPA Method 1312 Leachate 10
   - 6.3. Equilibration of USEPA Method 1320 Leachate 10

7. DISCUSSION 11

8. CONCLUSIONS 12

9. REFERENCES 12

LIST OF FIGURES

Page

Figure 1: Hole Locations for Imperial Project Waste Rock Samples 3

LIST OF TABLES

Page

Table 1: Rock Sample Types and Sample Locations 13
Table 2: Results of Whole Rock Analyses 14
Table 3: Static Test Results 15
Table 4: EPA Method 1312 Results 16
Table 5: EPA Method 1320 Results 17
Table 6: Geochemical Model Results 29

LIST OF APPENDICES

APPENDIX A: ANALYTICAL RESULTS OF WASTE ROCK ANALYSES

APPENDIX B: MODEL OUTPUT FOR EQUILIBRATION OF GROUND WATER (WC-5A) WITH WASTE BACKFILL MATERIAL

APPENDIX C: MODEL OUTPUT FOR EQUILIBRATION OF 1312 LEACHATE - SAMPLE E-2 SERICITE GNEISS

APPENDIX D: MODEL OUTPUT FOR EQUILIBRATION OF 1312 LEACHATE - SAMPLE E-4 GRAVEL

APPENDIX E: MODEL OUTPUT FOR EQUILIBRATION OF 1312 LEACHATE - SAMPLE W-2 BIOTITE GNEISS

APPENDIX F: MODEL OUTPUT FOR EQUILIBRATION OF 1320 LEACHATE - SAMPLE E-1 SERICITE GNEISS

CHEMGOLD, INC. IMPERIAL PROJECT
IMPERIAL COUNTY, CALIFORNIA

SUPPLEMENTAL WASTE CHARACTERIZATION STUDY

1. INTRODUCTION

Chemgold, Inc. (Chemgold) has proposed the development of a conventional open-pit, heap leach, precious metal mine, the Imperial Project (Project), to be located in eastern Imperial County, California, approximately 45 miles northeast of El Centro, California and 20 miles northwest of Yuma, Arizona. A joint Draft Environmental Impact Statement and Environmental Impact Report (EIS/EIR) is being prepared by the Bureau of Land Management (BLM) office in El Centro, California and the Imperial County Planning/Building Department.

In support of this EIS/EIR, Environmental Management Associates, Inc. (EMA) prepared, in December 1995, a report entitled "Chemgold, Inc., Imperial Project, Imperial County, Waste Characterization Study" (Waste Characterization). After publication of the Waste Characterization, questions were raised regarding the possible effects of Chemgold's proposed backfilling following the completion of mining of one (1) or more of the Project pits with the waste rock (overburden and interburden material) produced during active mining. This report supplements the Waste Characterization and presents the results of geochemical analyses of sampled potential waste rock and geochemical modeling that address the potential impacts to ground water quality in the area due to the planned backfilling of the pits with waste rock.

2. OBJECTIVE

EMA was requested to conduct a geochemical investigation to provide supporting documentation in analyzing potential impacts to ground water resources from the proposed backfilling of either or both the West Pit and/or the East Pit with waste rock material. Potential impacts to ground water resources could result from:

- Acid generation from the waste rock materials and consequent mobilization of dissolved constituents; and

- Mobilization of dissolved constituents due to the interaction of the backfilled waste rock and inflowing ground water.

The objective of the geochemical investigation is to provide representative information to:

- Evaluate the potential for acid generation from the waste rock backfill materials;

- Evaluate the potential for the mobilization of dissolved constituents from the backfilled waste rock materials in the pits when the pit(s) become saturated with inflowing ground water; and

- Evaluate the potential for impacts to ground water quality at the Project mine and process area and downgradient from the Project mine and process resulting from the interactions of the backfilled waste rock materials and the inflowing ground water.

3. LITHOLOGIES AND SAMPLING METHODS

A total of nine (9) samples, representing the four (4) lithologies of the waste rock material which may be backfilled into either the West Pit or the East Pit, were collected for geochemical analysis.

The four (4) Project waste rock lithologic types are:

(1) Biotite gneiss;

(2) Sericite gneiss;

(3) Volcanics;

(4) Gravels.

The biotite gneiss is generally dark brown and oxidized. It is primarily composed of quartz, plagioclase, biotite, and potassium feldspar, with abundant secondary calcite and minor muscovite and chlorite as alteration products. Oxidation products include hematite, goethite, jarosite, and manganese oxides.

The sericite gneiss is a light brown, strongly oxidized rock. It is composed of quartz, plagioclase, sericite, potassium feldspar, muscovite, and minor calcite. Hydrous iron oxides occur as oxidation products.

The volcanics are of basaltic composition, and the Project waste rock gravels are of fanglomeratic origin.

The samples were collected from reverse circulation (RC) drill hole cuttings composited from discrete depth intervals from exploration drill holes drilled in the areas of the West Pit and East Pit. Sample locations are shown on Figure 1, and sample rock type information are shown in Table 1.

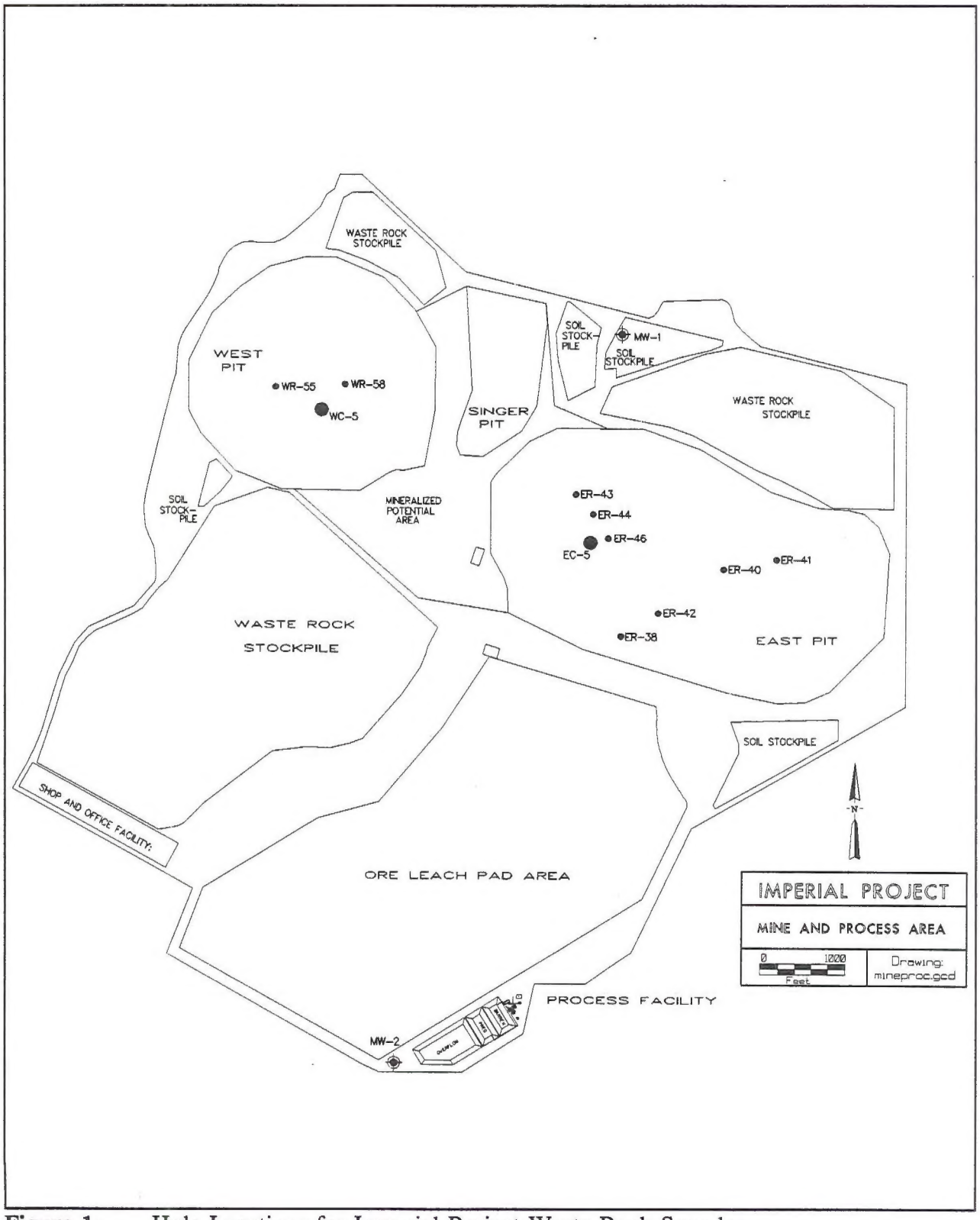


Figure 1: Hole Locations for Imperial Project Waste Rock Samples

Each sample interval was composited using a "Jones" splitter set to a 50:50 split. The initial fifty percent split was collected and mixed. The sample splitting continued until a composite of approximately 40 pounds per sample was collected for analysis by geochemical testing procedures.

4. GEOCHEMICAL TESTING PROCEDURES

The geochemical characterization of the waste rock materials utilized the following testing procedures:

- Whole rock analyses;
- Static acid/base accounting methods;
- U.S. Environmental Protection Agency (USEPA) Method 1312 (synthetic precipitation leach test, single extraction); and
- USEPA Method 1320 (synthetic precipitation leach test, multiple extraction).

The testing procedures and the analytical results are presented in the following sections.

4.1. Whole Rock Analyses

The whole rock analyses were conducted to characterize the mine materials for the following major and trace elements:

silica	aluminum
iron	magnesium
calcium	sodium
potassium	titanium
phosphorus	manganese
chromium	barium
nickel	strontium
zirconium	yttrium
niobium	scandium

Whole rock analyses were conducted on each of the nine (9) composite samples using an ICP method. The whole rock analyses were used to corroborate the rock type determinations and to evaluate, in a general manner, the components that may be available for mobilization.

4.2. Static Test Methods

Static tests were conducted on each of the nine (9) samples. The static test is an acid-base accounting procedure used as a screening technique for determining whether sample material has the potential to generate or consume acid. These tests assess the potential for sample material, based on sulfur analyses, to generate acid or consume acid by estimating the balance between the acid-generating and the acid-neutralizing capacity of the sample material. Separate tests are used to determine the acid generation potential and acid neutralization potential of the sample material.

The acid-generating potential (AGP) of the sample material involves determining the total amount of sulfur and sulfur species present. The sulfur species are the various oxidation states that sulfur may exist as in the rock. The two (2) most important sulfur species are sulfide sulfur (S^-), the reduced form of sulfur present in pyrite and other sulfide minerals, and sulfate sulfur (SO_4^{-2}), the oxidized form of sulfur produced, in part, from the oxidation of sulfide minerals. The total sulfur is a determination of the total concentration of all sulfur, both oxidized and reduced, in the sample material. This value can be conservatively used to evaluate the acid-generating potential of the sample material by assuming all forms of sulfur are acid-generating. Pyritic sulfur (S^-) is a more realistic estimation of the quantity of sulfur material that is likely to form acid upon oxidation. Sulfate sulfur (SO_4^{-2}) represents sulfur in its most oxidized form, some of which may be derived from oxidized sulfide material.

The acid neutralization potential (ANP) is determined by treating the sample material with a known excess of standardized hydrochloric acid. The sample material and acid are heated to ensure that all reactions between the acid and any neutralizing components present in the sample material go to completion. The acid neutralization potential is then measured by quantifying the amount of unconsumed acid by titrating with standardized sodium hydroxide.

Both the acid generation potential and the neutralization potential are expressed as tons of calcium carbonate ($CaCO_3$) per thousand tons of material. This value represents the amount of calcium carbonate that would be needed to neutralize 1,000 tons of material. The *net* acid generation potential of the material is determined by subtracting the acid generation potential from the acid neutralization potential, the result of which may be reported as either positive or negative. A negative result indicates a sample which can be expected to generate net acidity at some point in time. Alternatively, a positive result indicates a sample which will not be a net acid generator. Samples may be considered *potentially* acid-generating when the ratio of the neutralization potential to the acid generation potential is less than 1.20, i.e., NP:AP $<$ 1.20, even when the sample is determined to be strictly acid-neutralizing based on the difference between the acid neutralization and acid generation potentials. This is equivalent to a 20 percent excess

neutralization potential. This approach to the interpretation of static test results is advantageous since ratios are used instead of absolute values of the net neutralization potential, thus providing a constant factor of safety.

4.3. USEPA Method 1312 - Synthetic Precipitation Leach Test

The synthetic precipitation leach test (USEPA Method 1312) was conducted on one (1) sericite gneiss sample, one (1) gravel sample, and one (1) biotite gneiss sample. The purpose of USEPA Method 1312 is to simulate conditions under which precipitation might leach out constituents present in the sample material. Method 1312 is used by the USEPA and other federal agencies to determine the mobility of constituents present in soils and mine materials. In the USEPA Method 1312 analysis, a sample is saturated with deionized water buffered to pH 5.00 with a sulfuric acid/nitric acid mixture and bottle-rolled for 18 hours. After 18 hours, the resulting lixiviant is filtered and analyzed for dissolved constituents. The results of the lixiviant analyses are compared to appropriate water quality or other standards to determine what constituents in the sample material have the potential to mobilize and impact ground water and surface water.

4.4. USEPA Method 1320 - Multiple Extraction Procedure

The multiple extraction procedure (USEPA Method 1320) was conducted on one (1) biotite gneiss sample, two (2) sericite gneiss samples, one (1) volcanic sample, and two (2) gravel samples. The purpose of the USEPA Method 1320 analysis is to simulate leaching that a sample will undergo from repetitive precipitation events via a set of ten (10) sequential extractions. The initial extraction uses USEPA Method 1310, a toxicity extraction method. The sample is saturated with deionized water buffered with acetic acid to a pH of 5.00 and bottle-rolled for 24 hours. The leachate is filtered and analyzed for dissolved constituents. Extractions 2 through 10 are leached using a solution of distilled water buffered with a sulfuric acid/nitric acid mixture to a pH of 3.00 and each bottle-rolled for 24 hours. The leachate from each extraction is filtered and analyzed for dissolved constituents. The results of the leachate analyses are compared to appropriate water quality standards to determine the potential for impacts to water resources.

5. ANALYTICAL RESULTS

Laboratory data sheets for all of the analyses summarized in Table 2 through Table 5 are included as Appendix A.

5.1. Whole Rock Analytical Results

The results of the whole rock analyses are shown in Table 2. The sericite gneiss, biotite gneiss, and gravel samples have similar whole rock compositions, indicating that the gravel is composed primarily of gneissic material. The volcanic sample is lower in silica and higher in calcium and magnesium than the gneiss and gravel samples. This is expected in a rock of basaltic composition.

5.2. Static Test Results

The results of static test acid-base accounting analyses are shown in Table 3. The results show that one (1) of the nine (9) samples, the volcanic lithology, has small potential to generate acid. The pyritic acid-generating potential for the volcanic sample is a low 0.5 tons $CaCO_3$ per 1,000 tons of material, and the neutralizing potential is zero (0), yielding a low net neutralizing potential (NNP) of -0.5 tons $CaCO_3$ per 1,000 tons of material. The remaining eight (8) samples had NNP values that were greater than zero (0) and are moderately to substantially acid-neutralizing. The three (3) sericite gneiss samples had NNP values from 3.1 to 36.0 tons $CaCO_3$; the three (3) gravel samples have NNP values of 25.6 to 36.8 tons $CaCO_3$ per 1,000 tons of material; and the two (2) biotite gneiss samples have NNP values of 41.7 and 68.8 tons $CaCO_3$ per 1,000 tons of material.

5.3. USEPA Method 1312 Analytical Results

The results of USEPA Method 1312 analyses on the samples of sericite gneiss, gravel, and biotite gneiss are presented in Table 4. Constituent concentrations from ground water samples taken from the Project mine and process area are also shown for comparison (EMA, 1996).

The dissolved constituent concentrations in the leachate from the USEPA Method 1312 analyses are low, particularly when compared to the background ground water concentrations. Chloride, sulfate, sodium, and total dissolved solids (TDS) concentrations are all high in the ground water sample, which is typical of the ground water chemistry throughout the hydrologic basin (EMA, 1996). In the three (3) USEPA Method 1312 leachate samples, chloride ranges from 0.8 mg/l to 2.3 mg/l, compared to 162 mg/l in the ground water; sulfate is 24 mg/l in the gravel leachate sample and non-detect in the gneiss samples, compared to 310 mg/l in the ground water; sodium ranges from 6 mg/l to 21 mg/l, compared to 233 mg/l in the ground water; and TDS ranges from 180 mg/l to 250 mg/l, compared to 1,160 mg/l in the ground water.

The pH of the USEPA Method 1312 leachates from the sericite gneiss, gravel, and biotite gneiss is 7.81, 8.21, and 8.21, respectively, compared to the pH in the ground

water of 7.61. Aluminum, barium, selenium, and zinc were present at low concentrations in the USEPA Method 1312 leachate samples, but were not detected in the ground water. Relatively high concentrations of manganese in the ground water sample are typical of all the ground water samples collected from the Project mine and process area.

The selenium concentrations of 0.05 mg/l and 0.07 mg/l in the sericite gneiss and gravel leachates, respectively, reach or exceed the California primary maximum contaminant level (MCL) of 0.05 mg/l of selenium for drinking water. Iron and manganese concentrations exceeded the secondary drinking MCLs of 0.3 mg/l and 0.05 mg/l, respectively, in two (2) of the leachate samples.

5.4. USEPA Method 1320 Analytical Results

The results of USEPA Method 1320 analyses on six (6) waste rock samples are provided in Table 5. The analytical results for extractions 1 through 10 are presented for each sample.

The dissolved constituent concentrations in the initial extraction leachate for each sample are greater than all subsequent extraction leachates. Sample E-5 (sericite gneiss) has the lowest concentrations of dissolved constituents in the first extraction leachate. Alkalinity is below the detection limit of 5 mg/l, calcium is 65.7 mg/l, manganese is 0.41 mg/l, and TDS is 430 mg/l. For the remaining five (5) samples, alkalinity ranges from 540 mg/l to 1,740 mg/l; calcium from 494 mg/l to 1,370 mg/l; manganese from 1.49 mg/l to 10.4 mg/l; and TDS from 2,090 mg/l to 5,930 mg/l. The concentrations of these constituents are all much greater than the applicable concentrations in the background ground water sample, which are also presented in Table 5. In addition, aluminum concentrations in the initial USEPA Method 1320 leachates ranged from 0.11 mg/l to 0.67 mg/l, compared to less than 0.02 mg/l in the ground water sample. Iron was below the detection limit of 0.3 mg/l in all of the initial USEPA Method 1320 extraction leachates, compared to a concentration of 0.60 mg/l in the background ground water sample. Sulfate and chloride concentrations were also generally low in the initial USEPA Method 1320 leachates, compared to the background ground water concentrations of 310 mg/l and 162 mg/l, respectively.

The concentrations of dissolved constituents in the leachates from extractions 2 through 10 were all low. Alkalinity was below the detection limit of 5 mg/l in all leachates from extractions 2 through 10. Aluminum, sulfate, calcium, and manganese were present in sample leachates from extractions 2 through 10. For most of the samples, iron was present in the later leachate extractions at concentrations above the detection limit of 0.3 mg/l.

6. GEOCHEMICAL MODELING

To test the effects of the ground water inflowing to the pits and equilibrating with the backfill material under earth surface conditions, geochemical models were run and the results evaluated relative to background ground water quality and to potential impacts to ground water quality downgradient from the pits.

The USEPA geochemical model MINTEQA2 (Allison, et al, 1991) was developed to apply fundamental principles of thermodynamics to solve geochemical equilibria using mass balance relations and an aqueous speciation-solubility-adsorption model. The computer code uses its own thermodynamic database, which may be modified as new or updated data become available.

MINTEQA2 was used to speciate the chemical forms of the dissolved constituents in the water that equilibrates with the backfill waste material and to determine the effects of mineral precipitation on the final dissolved concentrations of these constituents. Unless otherwise noted below, carbon dioxide was input at a partial pressure of $1.0 \times 10^{-3.5}$ atmospheres, equivalent to earth surface atmospheric conditions. Other specific input parameters are described in the sections for each model run.

6.1. Equilibration of Inflowing Ground Water with Backfill Material

The ground water analysis most representative of that ground water which will flow into the pits is WC-5A, collected from the corehole in the area of the West Pit (EMA, 1996). The most reactive mineral phase present in the waste rock lithologies is calcite. Therefore, in the geochemical model, ground water with a composition equivalent to sample WC-5A is equilibrated with an infinite mass of calcite. The assumption of an infinite mass of calcite being available to equilibrate with the inflowing ground water is based on the backfill waste rock material having a high surface area available to react and on calcite being reactive in the modeled system. In addition, carbon dioxide was input with a partial pressure of $1.0 \times 10^{-3.5}$ atmospheres, equivalent to the earth surface conditions under which the system will equilibrate.

The model results of the inflowing ground water equilibrating with calcite are provided in Appendix B. These results are summarized and compared to the background ground water quality in Table 6. The final model pH is 8.48, compared to the background value of 7.61. Dissolved manganese precipitated as a manganese hydroxide. The concentrations of all other dissolved constituents remained approximately the same as the background inflowing ground water concentrations.

6.2. Equilibration of USEPA Method 1312 Leachate

Geochemical models were run using as input the results of each of the three (3) USEPA Method 1312 analyses equilibrating with an infinite mass of calcite. These models were run to simulate only the contribution of those constituents which might leach from the wallrock as the ground water flowed into the pits.

The model results of the USEPA Method 1312 leachates equilibrating with calcite under atmospheric conditions are provided in Appendix C for the sericite gneiss sample, Appendix D for the gravel sample, and Appendix E for the biotite gneiss sample. These results are summarized and compared to the background ground water quality in Table 6. The final modeled pH ranged from 8.23-8.41, and the dissolved manganese and aluminum precipitated as insoluble hydroxides. The low concentrations of arsenic and mercury present in the USEPA Method 1312 leachates precipitated as barium arsenate and a mercury hydroxide during model equilibration. All other dissolved constituents have the same concentrations as the input concentrations.

6.3. Equilibration of USEPA Method 1320 Leachate

A geochemical model was run for one (1) sample of the first extraction from the USEPA Method 1320 analyses. The results of the USEPA Method 1320 analyses indicated, based on the high calcium and alkalinity concentrations, that the leachate is over-saturated relative to calcite; therefore, the geochemical model was run using the USEPA Method 1320 results as input and assuming that calcite could precipitate during equilibration with the backfill material. This model was run to simulate the contribution of constituents which might be derived from the wallrock under more rigorous leaching conditions than the USEPA Method 1312 analyses as the ground water flowed into the pits. Only the results of the first USEPA Method 1320 extraction were modeled since extractions 2 through 10 had very low concentrations of dissolved constituents for each of the samples.

The geochemical model results of the USEPA Method 1320 leachate from the sericite gneiss is provided in Appendix F. These results are summarized and compared to the background ground water quality in Table 6. As expected, the dissolved calcium and alkalinity precipitated as calcite. Manganese and aluminum precipitated as insoluble hydroxides, and some of the copper and zinc precipitated as insoluble oxides. The concentrations of all other dissolved constituents remained the same as the input concentrations.

7. DISCUSSION

Static tests and synthetic precipitation leach procedure analyses (USEPA Method 1312 and Method 1320) were conducted on samples of waste rock that will be used as backfill material in the pits after the mining operation ceases.

The results of the static tests show an overall high net neutralization potential (NNP) for the waste rock. Although the one (1) sample of basaltic volcanics had a slight acid-generating potential of 0.5 tons $CaCO_3$ per 1,000 tons of material, all other samples had moderate to substantial net neutralization potentials of from 10.3 to greater than 229 tons $CaCO_3$ per 1,000 tons of material; due primarily to the presence of secondary calcite and the lack of sulfide mineral phases from which acid could be generated. This, combined with the volcanic's very small percentage in the total waste rock lithology, will result in the average NNP of the waste rock being high.

The results of USEPA Method 1312 analyses show low concentrations of all constituents in the sample leachates compared to background water quality. The low concentrations of manganese and iron are present due to the dissolution of secondary oxides and oxyhydroxides. Selenium was present in two (2) samples at concentrations of 0.05 mg/l and 0.07 mg/l, at or greater than the drinking water MCL of 0.05 mg/l. Selenium may be present due to desorption from metal oxides.

The results of USEPA Method 1320 analyses show high dissolved constituent concentrations only in the first extraction. Extractions 2 through 10 generally show low concentrations except during the later extractions, when high iron concentrations are produced from oxide dissolution due to the low pH and lack of remaining buffering capacity in the sample. The high calcium and alkalinity concentrations are due to the dissolution of calcite during the initial extraction and contribute to the high total dissolved solids (TDS) concentrations in each leachate. The manganese and aluminum concentrations are due to the dissolution of manganese oxides and oxyhydroxides. The alkalinity, TDS, calcium, manganese, and aluminum concentrations are initially greater than the concentrations present in the background ground water. This is due to the more rigorous leaching of the USEPA Method 1320 extraction than the natural processes with which the ground water has equilibrated.

The geochemical models showed that metal oxides and oxyhydroxides will form from the dissolved constituents in the ground water and leachate samples, similar to the manganese and iron oxides present in the waste rock lithologies. In addition, the pH will be buffered to approximately 8.4 by the calcite in the waste rock and by the atmospheric partial pressure of carbon dioxide. Thus, the geochemical models show reasonable results for a ground water equilibrating with calcite under earth surface conditions.

8. CONCLUSIONS

Analyses were conducted on samples of waste rock that may be used as backfill material in the Project pits following cessation of mining. Static tests and synthetic precipitation leach analyses (USEPA Method 1312 and Method 1320) were conducted to evaluate potential effects of the interaction of ground water flowing into the pit(s) with the backfilled waste rock material. The results of the analyses reveal the following:

(1) There is no potential for acid conditions to form in the any of the Project pits; and

(2) The interactions of the inflowing ground water with the backfilled waste rock material in the pits will not produce any substantial changes to ground water quality in the Project mine and process area or downgradient.

Geochemical models were run to evaluate the water quality after equilibration of the inflowing ground water with the backfilled waste rock material. The models were run assuming equilibration with calcite, the reactive mineral phase in the backfilled waste rock, and with a partial pressure of carbon dioxide of $1.0 \times 10^{-3.5}$ atmospheres, equivalent to earth surface atmospheric conditions. The results of the geochemical models show that the pH of the impounded water in the pits will be approximately 8.3 to 8.5, and that the dissolved constituent concentrations will be approximately equal to the existing background ground water concentrations.

The results of the laboratory analyses and the geochemical modeling show that, compared with the existing background water quality in the Project mine and process area, no substantial change to water quality at the Project mine and process area or downgradient of the mine site will occur.

9. REFERENCES

Environmental Management Associates, 1996: *Supplemental Hydrology Study, Imperial Project, Imperial County, California.* September 1996.

Allison, J.D., D.S. Brown, and K.J. Novo-Gradac, 1991: *MINTEQA2/PRODEFA2, A Geochemical Assessment Model for Environmental Systems: Version 3.0 Users Manual.* U.S. Environmental Protection Agency Office of Research and Development; Environmental Research Laboratory, Athens, Georgia. EPA/600/3-91/021.

Table 1: Rock Sample Types and Sample Locations

Pit	Sample	Rock Type	Sample Drill Hole	Sample Depth (ft)
East	E-1	sericite gneiss	ER-44	700-820
East	E-2	sericite gneiss	ER-46	700-870
East	E-3	gravel	ER-40/ER-41/ER-42	0-300/0-120/0-200
East	E-4	gravel	ER-38/ER-43/ER-46	0-200/0-350/0-110
East	E-5	sericite gneiss	ER-44	525-560
East	E-6	volcanic	ER-43/ER-46	410-440/525-560
West	W-1	biotite gneiss	WR-55	580-780
West	W-2	biotite gneiss	WR-58	580-760
West	W-3	gravel	WR-58	0-180

Table 2: Results of Whole Rock Analyses

Analyte[1]	E-1	E-2	E-3	E-4	E-5	E-6	W-1	W-1[2]	W-2	W-3
	Sericite Gneiss	Sericite Gneiss	Gravel	Gravel	Sericite Gneiss	Volcanic	Biotite Gneiss	Biotite Gneiss	Biotite Gneiss	Gravel
SiO_2	65.17	65.49	66.54	66.32	73.85	47.76	66.06	65.99	61.98	67.33
Al_2O_3	14.64	14.87	13.40	13.80	13.60	14.15	13.82	13.77	14.83	13.60
Fe_2O_3	5.07	4.81	4.95	4.83	1.96	6.15	3.88	3.94	5.53	4.29
MgO	0.60	0.70	1.00	1.16	0.41	3.01	0.22	0.23	0.81	1.01
CaO	2.29	1.37	3.27	3.01	0.37	10.58	3.08	3.06	3.12	3.24
Na_2O	2.54	3.43	2.99	2.84	1.44	2.25	3.98	3.94	2.54	2.84
K_2O	5.13	4.49	3.45	3.27	4.91	1.11	4.02	4.24	4.80	4.76
TiO_2	0.58	0.55	0.51	0.50	0.38	0.89	0.44	0.46	0.69	0.44
P_2O_5	0.08	0.17	0.10	0.11	0.03	0.19	0.09	0.12	0.26	0.09
MnO	0.11	0.12	0.09	0.08	0.03	0.12	0.08	0.08	0.13	0.06
Cr_2O_3	0.003	0.002	0.005	<0.001	0.003	0.016	0.001	0.003	0.003	0.003
Ba	736	955	1,172	1,095	516	1,020	756	756	974	1,415
Ni	<20	<20	22	<20	<20	39	<20	<20	<20	<20
Sr	218	221	257	278	97	553	104	105	190	294
Zr	173	163	145	198	175	139	117	107	136	144
Y	25	19	17	17	26	16	19	18	21	14
Nb	16	14	11	11	22	15	14	14	16	12
Sc	<10	<10	<10	<10	<10	10	<10	<10	<10	<10
LOI[3]	3.7	3.1	3.0	3.2	2.0	13.3	3.3	3.3	4.4	2.6
SUM	100.01	99.32	99.56	99.39	99.11	99.79	99.13	99.30	99.31	100.56

[1]Units: oxides in percent, metals in ppm
[2]Rerun sample
[3]Loss on Ignition

Table 3: Static Test Results

Sample Number	Sample Rock Type	Sulfur Species (%)			ANP	AGP (pyritic)	NNP	ANP:AGP
		Total	Sulfate	Pyritic	tons $CaCO_3$/kT			
E-1	sericite gneiss	<0.01	<0.01	0.01	36.4	0.4	36.0	91.0
E-2	sericite gneiss	0.02	<0.01	<0.01	20.5	<0.3	20.5	>68.4
E-3	gravel	<0.01	<0.01	0.01	37.2	0.4	36.8	93.0
E-4	gravel	<0.01	<0.01	0.02	26.2	0.6	25.6	43.7
E-5	sericite gneiss	<0.01	<0.01	<0.01	3.1	<0.3	3.1	>10.3
E-6	volcanic	<0.01	<0.01	0.02	<0.1	0.5	-0.5	<0.2
W-1	biotite gneiss	<0.01	<0.01	<0.01	68.8	<0.3	68.8	>229
W-2	biotite gneiss	<0.01	<0.01	0.01	42.1	0.4	41.7	105
W-3	gravel	0.05	<0.01	0.01	31.0	0.4	30.6	77.5

ANP: acid-neutralizing potential
AGP: acid-generating potential
NNP: net-neutralizing potential

Table 4: EPA Method 1312 Results

Analytes (mg/l)	Ground Water Quality (Sample WC-5A [EMA, 1996]) (mg/l)	Sample		
		E-2 sericite gneiss	E-4 gravel	W-2 biotite gneiss
Alkalinity (as $CaCO_3$)	210	38	40	34
Chloride	162	1.8	2.3	0.8
Fluoride	0.8	0.2	0.2	0.1
Nitrate/Nitrite (as N)	0.06	<0.05	<0.05	<0.05
Phosphorus	0.03	0.02	0.07	0.05
Sulfate	310	<10	24	<10
pH	7.61	7.81	8.21	8.21
Aluminum	<0.02	0.34	0.11	0.32
Antimony	<0.005	<0.005	<0.005	<0.005
Arsenic	<0.01	<0.01	0.01	0.02
Barium	0.03	0.38	0.24	0.21
Beryllium	0.001	0.001	<0.001	<0.001
Bismuth	<1	<1	<1	<1
Boron	0.74	0.25	0.20	0.13
Cadmium	<0.005	<0.005	<0.005	<0.005
Calcium	59.4	13.8	27.0	11.8
Chromium	<0.01	<0.01	<0.01	<0.01
Cobalt	<0.03	<0.03	<0.03	<0.03
Copper	<0.01	<0.01	<0.01	<0.01
Gallium	<0.5	<0.5	<0.5	<0.5
Iron	0.60	0.10	<0.03	0.15
Lead	<0.003	<0.003	0.017	0.005
Lithium	0.07	<0.01	<0.01	<0.01
Magnesium	16.1	0.6	0.7	0.8
Manganese	0.47	0.13	0.09	0.04
Mercury	<0.0002	<0.0002	<0.0002	0.0004
Molybdenum	<0.05	<0.05	<0.05	<0.05
Nickel	<0.04	<0.04	<0.04	<0.04
Potassium	12	<5	<5	<5
Scandium	<0.01	<0.01	<0.01	<0.01
Selenium	<0.01	0.05	0.07	<0.01
Silver	<0.01	<0.01	<0.01	<0.01
Sodium	233	8	21	6
Strontium	1.30	0.21	0.09	0.35
Thallium	<0.002	<0.002	<0.002	<0.002
Tin	<0.05	<0.05	<0.05	<0.05
Titanium	<0.01	<0.01	<0.01	<0.01
Vanadium	<0.05	<0.05	<0.05	<0.05
Zinc	<0.01	0.35	0.21	0.19
Total Dissolved Solids	1,160	180	220	250

Table 5: EPA Method 1320 Results

SAMPLE E-1 (SERICITE GNEISS)										
Analytes (mg/l)	Extraction									
	1	2	3	4	5	6	7	8	9	10
Alkalinity (as $CaCO_3$)	1,040	<5	<5	<5	<5	<5	<5	<5	<5	<5
Chloride	3.4	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Fluoride	0.1	0.3	0.5	0.6	0.6	0.5	0.3	0.2	0.1	<0.1
Nitrate/Nitrite (as N)	1.90	5.6	3.22	3.47	8.9	20.4	2.59	3.44	6.5	2.75
Phosphorus	<0.01	0.36	2.9	0.08	2.53	2.35	0.98	0.40	0.13	<0.01
Sulfate	12	29	28	20	20	20	20	20	20	20
pH	5.45	4.36	4.26	3.90	3.40	1.82	3.66	2.71	3.33	3.59
Aluminum	0.11	0.22	0.51	0.51	0.57	0.46	0.26	0.27	0.25	0.25
Antimony	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Arsenic	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Barium	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Beryllium	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Bismuth	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Boron	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Cadmium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Calcium	689	19.5	14.5	11.0	10.4	10.3	6.0	5.9	5.0	4.9
Chromium	0.03	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cobalt	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Copper	0.13	0.03	0.05	0.05	0.05	0.07	0.05	0.06	0.06	0.08
Gallium	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Iron	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Lead	0.004	0.008	<0.003	<0.003	0.005	<0.003	<0.003	<0.003	0.003	0.004

SAMPLE E-1 (SERICITE GNEISS)										
Analytes (mg/l)	Extraction									
	1	2	3	4	5	6	7	8	9	10
Lithium	<0.01	<0.01	<0.01	0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Magnesium	4.9	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.4
Manganese	7.37	0.54	0.63	0.62	0.68	0.80	0.65	0.96	1.14	2.63
Mercury	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Molybdenum	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Nickel	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04
Potassium	22	<5	<5	<5	<5	<5	<5	<5	<5	<5
Scandium	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Selenium	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Silver	<0.01	0.01	<0.01	0.03	0.02	<0.01	<0.01	<0.01	<0.01	<0.01
Sodium	10	1	<1	1	1	<1	<1	<1	1	1
Strontium	1.50	0.06	0.05	0.04	0.04	0.04	0.02	0.03	0.04	0.06
Thallium	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Tin	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.06
Titanium	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Vanadium	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Zinc	1.3	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
TDS	3,050	110	60	40	50	20	40	40	30	30

SAMPLE E-3 (GRAVEL)										
Analytes (mg/l)	Extraction									
	1	2	3	4	5	6	7	8	9	10
Alkalinity (as $CaCO_3$)	540	<5	<5	<5	<5	<5	<5	<5	<5	<5
Chloride	4.2	<0.5	0.5	<0.5	0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Fluoride	0.3	0.6	0.5	0.2	<0.1	0.2	<0.1	<0.1	<0.1	<0.1
Nitrate/Nitrite (as N)	2.96	63.5	2.98	5.5	8.2	3.60	2.33	3.12	12.6	2.31
Phosphorus	0.04	0.66	0.04	0.06	0.10	<0.01	<0.01	<0.01	<0.01	<0.01
Sulfate	22	35	25	18	19	20	20	20	20	20
pH	4.99	1.92	4.44	3.72	3.67	2.65	5.05	4.88	2.20	3.26
Aluminum	0.41	0.37	0.48	0.35	0.18	<0.05	<0.05	0.08	0.06	<0.05
Antimony	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Arsenic	<0.01	0.02	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Barium	0.6	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Beryllium	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Bismuth	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Boron	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Cadmium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Calcium	494	17.3	11.6	6.6	4.5	2.5	1.7	1.3	1.4	0.7
Chromium	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cobalt	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Copper	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01
Gallium	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Iron	<0.3	<0.3	4.0	8.6	13.6	13.6	14.0	13.7	20.1	15.3
Lead	<0.003	0.005	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Lithium	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Magnesium	4.4	0.4	0.4	0.3	0.3	0.2	0.2	0.2	0.3	0.2
Manganese	2.01	0.58	0.63	0.51	0.50	0.41	0.44	0.50	0.49	0.34

SAMPLE E-3 (GRAVEL)										
Analytes (mg/l)	Extraction									
	1	2	3	4	5	6	7	8	9	10
Mercury	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Molybdenum	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Nickel	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04
Potassium	18	<5	<5	<5	<5	<5	<5	<5	<5	<5
Scandium	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Selenium	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Silver	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Sodium	18	1	<1	2	1	<1	<1	1	<1	<1
Strontium	0.69	0.04	0.03	0.03	0.02	0.01	0.01	0.01	0.01	<0.01
Thallium	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Tin	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Titanium	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Vanadium	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Zinc	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
TDS	2,090	100	60	50	60	70	50	50	50	60

SAMPLE E-5 (SERICITE GNEISS)										
Analytes (mg/l)	Extraction									
	1	2	3	4	5	6	7	8	9	10
Alkalinity (as $CaCO_3$)	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Chloride	2.0	<0.5	<0.5	0.5	<0.5	<0.5	0.8	<0.5	<0.5	<0.5
Fluoride	0.2	0.3	0.4	0.2	<0.1	0.2	<0.1	<0.1	<0.1	<0.1
Nitrate/Nitrite (as N)	3.52	7.10	3.05	4.20	4.43	7.4	2.43	2.47	2.76	2.40
Phosphorus	0.21	2.29	0.57	0.38	0.23	0.04	0.02	<0.01	<0.01	<0.01
Sulfate	16	26	24	20	20	20	20	20	20	20
pH	2.86	3.53	3.66	3.42	3.36	2.34	3.68	4.07	3.34	4.63
Aluminum	0.30	0.44	0.37	0.29	0.62	0.12	0.10	0.12	0.06	0.06
Antimony	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Arsenic	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Barium	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Beryllium	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Bismuth	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Boron	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Cadmium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Calcium	65.7	13.5	9.6	5.0	3.3	2.9	1.7	1.5	0.6	0.6
Chromium	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cobalt	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Copper	0.03	0.01	<0.01	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.01
Gallium	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Iron	<0.3	<0.3	<0.3	0.5	1.4	4.1	8.5	12.5	14.5	16.3
Lead	<0.003	0.005	0.005	0.009	<0.003	0.007	0.005	<0.003	<0.003	<0.003
Lithium	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Magnesium	2.3	0.5	0.3	0.3	0.1	0.1	<0.1	0.2	<0.1	<0.1
Manganese	0.41	0.13	0.11	0.09	0.09	0.11	0.12	0.14	0.11	0.12

SAMPLE E-5 (SERICITE GNEISS)										
Analytes (mg/l)	Extraction									
	1	2	3	4	5	6	7	8	9	10
Mercury	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Molybdenum	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Nickel	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04
Potassium	8	<5	<5	<5	<5	<5	<5	<5	<5	<5
Scandium	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Selenium	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Silver	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Sodium	5	1	<1	2	<1	<1	<1	1	<1	<1
Strontium	0.69	0.13	0.08	0.04	0.03	0.03	0.02	0.02	<0.01	<0.01
Thallium	0.022	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Tin	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Titanium	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Vanadium	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Zinc	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
TDS	430	60	50	30	30	70	40	50	60	60

SAMPLE E-6 (VOLCANIC)										
Analytes (mg/l)	Extraction									
	1	2	3	4	5	6	7	8	9	10
Alkalinity (as $CaCO_3$)	1,740	20	20	<5	<5	<5	<5	<5	<5	<5
Chloride	6.0	<0.5	<0.5	<0.5	0.6	<0.5	<0.5	<0.5	<0.5	<0.5
Fluoride	<0.1	0.1	0.3	0.4	0.4	0.4	0.2	0.2	0.1	0.2
Nitrate/Nitrite (as N)	7.4	6.3	2.91	3.46	3.86	3.66	2.62	3.42	10.8	3.30
Phosphorus	0.35	0.48	0.29	1.8	1.86	1.04	0.50	0.29	0.22	0.06
Sulfate	59	28	25	24	26	20	20	20	20	20
pH	5.12	5.16	5.12	3.97	3.82	2.87	4.95	4.64	4.38	2.71
Aluminum	0.32	0.08	0.11	0.30	0.34	0.28	0.23	0.17	0.20	0.09
Antimony	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Arsenic	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Barium	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Beryllium	0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Bismuth	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Boron	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Cadmium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Calcium	1,370	33.0	17.7	15.9	14.8	13.4	11.7	13.3	14.5	10.7
Chromium	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cobalt	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Copper	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Gallium	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Iron	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	0.4	1.0	2.0	2.5
Lead	<0.003	<0.003	0.004	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Lithium	0.04	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Magnesium	11.7	0.5	0.3	0.4	0.4	0.4	0.4	0.5	0.5	0.4
Manganese	3.28	0.13	0.10	0.13	0.23	0.37	0.42	0.55	0.50	0.40

SAMPLE E-6 (VOLCANIC)										
Analytes (mg/l)	Extraction									
	1	2	3	4	5	6	7	8	9	10
Mercury	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Molybdenum	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Nickel	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04
Potassium	41	<5	<5	<5	<5	<5	<5	<5	<5	<5
Scandium	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Selenium	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Silver	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Sodium	49	3	<1	2	1	<1	1	1	1	<1
Strontium	5.18	0.17	0.07	0.07	0.07	0.06	0.05	0.06	0.07	0.05
Thallium	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Tin	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Titanium	0.03	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Vanadium	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Zinc	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
TDS	5,930	180	70	90	80	80	40	70	80	60

SAMPLE W-1 (BIOTITE GNEISS)										
Analytes (mg/l)	Extraction									
	1	2	3	4	5	6	7	8	9	10
Alkalinity (as $CaCO_3$)	1,120	<5	<5	<5	<5	<5	<5	<5	<5	<5
Chloride	3.4	<0.5	<0.5	<0.5	0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Fluoride	<0.1	<0.1	0.8	0.7	0.6	0.7	0.4	0.2	<0.1	<0.1
Nitrate/Nitrite (as N)	1.50	6.10	2.92	4.71	9.7	5.4	2.49	3.10	3.18	3.66
Phosphorus	0.04	0.03	0.03	2.7	2.86	2.50	1.38	0.29	0.03	<0.01
Sulfate	47	27	28	22	21	20	20	20	20	20
pH	5.05	4.19	4.15	3.60	3.29	2.33	3.64	3.42	3.40	2.95
Aluminum	0.41	0.17	0.90	0.75	0.74	0.63	0.50	0.47	0.65	0.75
Antimony	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Arsenic	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Barium	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Beryllium	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Bismuth	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Boron	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Cadmium	0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Calcium	1,080	17.9	14.9	10.7	9.1	8.3	6.2	4.4	2.0	1.3
Chromium	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cobalt	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Copper	0.05	<0.01	<0.01	<0.01	<0.01	0.02	0.01	0.02	<0.01	0.01
Gallium	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Iron	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	0.9
Lead	<0.003	0.003	0.004	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Lithium	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Magnesium	2.8	0.2	0.2	0.2	0.1	0.1	0.1	0.2	0.1	<0.1
Manganese	10.4	0.75	0.62	0.60	0.54	0.55	0.71	0.96	0.92	1.37

SAMPLE W-1 (BIOTITE GNEISS)										
Analytes (mg/l)	Extraction									
	1	2	3	4	5	6	7	8	9	10
Mercury	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Molybdenum	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Nickel	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04
Potassium	17	<5	<5	<5	<5	<5	<5	<5	<5	<5
Scandium	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Selenium	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Silver	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Sodium	4	2	<1	1	1	<1	1	1	1	<1
Strontium	0.70	0.04	0.04	0.03	0.02	0.02	0.02	0.02	0.02	0.02
Thallium	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	0.002
Tin	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Titanium	0.03	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Vanadium	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Zinc	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
TDS	4,470	130	60	50	50	80	20	30	20	

SAMPLE W-3 (GRAVEL)										
Analytes (mg/l)	Extraction									
	1	2	3	4	5	6	7	8	9	10
Alkalinity (as $CaCO_3$)	1,140	<5	<5	<5	<5	<5	<5	<5	<5	<5
Chloride	9.3	<0.5	<0.5	<0.5	<0.5	<0.5	0.5	<0.5	<0.5	<0.5
Fluoride	1.0	0.9	0.9	0.4	0.2	0.2	<0.1	<0.1	<0.1	<0.1
Nitrate/Nitrite (as N)	3.98	6.1	3.06	2.98	5.1	5.9	2.30	2.94	2.98	2.41
Phosphorus	0.10	1.21	0.24	0.66	0.24	0.03	<0.01	<0.01	<0.01	<0.01
Sulfate	260	32	24	19	17	20	20	20	20	20
pH	5.36	3.90	4.28	4.17	3.27	2.29	4.89	4.80	4.62	4.88
Aluminum	0.67	0.69	0.70	0.39	0.32	0.15	0.08	0.14	0.14	0.06
Antimony	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Arsenic	0.01	0.02	0.07	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Barium	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Beryllium	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Bismuth	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Boron	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Cadmium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Calcium	805	19.6	13.0	7.8	5.3	3.9	1.8	2.2	1.2	0.9
Chromium	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cobalt	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Copper	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Gallium	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Iron	<0.3	<0.3	1.2	4.8	8.9	14.2	14.4	15.3	13.8	7.2
Lead	<0.003	<0.003	<0.003	<0.003	0.004	<0.003	<0.003	<0.003	<0.003	<0.003
Lithium	0.02	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Magnesium	4.9	0.4	0.4	0.4	0.3	0.3	0.3	0.4	0.3	0.2
Manganese	1.49	0.37	0.43	0.36	0.30	0.30	0.27	0.35	0.23	0.11

SAMPLE W-3 (GRAVEL)										
Analytes (mg/l)	Extraction									
	1	2	3	4	5	6	7	8	9	10
Mercury	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Molybdenum	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Nickel	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04
Potassium	17	<5	<5	<5	<5	<5	<5	<5	<5	<5
Scandium	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Selenium	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Silver	0.02	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Sodium	20	2	<1	1	1	<1	<1	2	1	<1
Strontium	1.26	0.10	0.06	0.04	0.03	0.02	0.01	0.02	0.01	<0.01
Thallium	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Tin	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Titanium	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Vanadium	0.51	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Zinc	2.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
TDS	3,430	100	70	50	60	80	40	50	60	50

Table 6: Geochemical Model Results

Analyte (mg/l)	Background Groundwater (WC-5A) (mg/l)	Sample (mg/l)				
		Groundwater	1312			1320
		WC-5A	E-2	E-4	W-2	E-1
pH	7.61	8.48	8.29	8.23	8.41	8.48
Sulfate	310	310	ND	24	ND	40
Strontium	1.30	1.30	0.21	0.09	0.35	1.5
Beryllium	0.001	0.001	0.001	ND	ND	ND
Boron	0.74	0.74	0.25	0.20	0.13	ND
Chloride	162	162	1.8	2.3	0.8	3.4
Fluoride	0.8	0.002	0.002	0.002	0.003	0.100
Lithium	0.07	0.07	ND	ND	ND	ND
Magnesium	16.1	16.1	0.6	0.7	0.8	4.9
Potassium	12	12.	ND	ND	ND	22
Nitrate N	0.06	0.27	ND	ND	ND	1.9
Phosphorus	0.03	0.009	0.003	0.002	0.004	ND
Calcium	59.4	13.9	19.6	28.6	11.5	9.5
Alkalinity (CO_3)	201	100	59.6	51.8	77.1	92.5
Iron	0.60	0.10	0.01	ND	ND	ND
Sodium	233	233	8	21	6	10
Manganese	0.47	3.1×10^{-21}	5.5×10^{-21}	9.7×10^{-21}	2.4×10^{-21}	ND
Barium	0.03	0.01	0.38	0.10	0.16	ND
Arsenic	<0.01	ND	ND	8.6×10^{-8}	2.5×10^{-8}	ND
Zinc	<0.01	ND	0.35	0.21	0.19	0.9
Lead	<0.003	ND	ND	0.017	0.005	0.004
Selenium	<0.01	ND	0.05	0.07	ND	ND
Aluminum	<0.02	ND	0.0004	0.0004	0.0006	0.0007
Mercury	<0.0002	ND	ND	ND	1.3×10^{-6}	ND
Chromium	<0.01	ND	ND	ND	ND	0.03
Copper	<0.01	ND	ND	ND	ND	0.06

ND: not detected in the input analytical data

This page intentionally left blank
for reproduction purposes.

APPENDIX A

ANALYTICAL RESULTS OF WASTE ROCK ANALYSES

The information otherwise contained in this
Appendix/Attachment has been deleted from the
Draft Environmental Impact Statement/Environmental Impact Report (DEIS/EIR).

This deleted information can be found in its entirety at the
Bureau of Land Management
El Centro Resource Area Office

APPENDIX B

MODEL OUTPUT FOR EQUILIBRATION OF GROUND WATER (WC-5A) WITH WASTE BACKFILL MATERIAL

```
EQUILIBRATION OF GROUNDWATER (WC-5A) WITH WASTE BACKFILL MATERIAL
pCO2=10E-3.5; INFINITE CALCITE, HEMATITE, APATITE

25.00 MG/L   0.000  0.00000E-01
0 0 1 2 2 0 0 0 1 1 0 0 0
0   0   0
    330  2.470E-05   -7.61 y                  /H+1
    140  1.206E+02   -2.70 y                  /CO3-2
    100  3.000E-02   -6.66 y                  /Ba+2
    110  1.000E-03   -6.95 y                  /Be+2
     90  4.235E+00   -4.16 y                  /H3BO3
    150  5.940E+01   -2.83 y                  /Ca+2
    180  1.620E+02   -2.34 y                  /Cl-1
    270  8.000E-01   -4.38 y                  /F-1
    440  7.000E-02   -5.00 y                  /Li+1
    460  1.610E+01   -3.18 y                  /Mg+2
    471  4.700E-01   -5.07 y                  /Mn+3
    492  2.657E-01   -5.37 y                  /NO3-1
    580  3.000E-02   -6.50 y                  /PO4-3
    410  1.200E+01   -3.51 y                  /K+1
    500  2.330E+02   -1.99 y                  /Na+1
    800  1.300E+00   -4.83 y                  /Sr+2
    732  3.100E+02   -2.49 y                  /SO4-2
      1  0.000E-01   -0.85 y                  /E- (ENTERED AS EH)
    281  5.000E-01   -5.27                     /Fe+3
    280  1.000E-01   -5.27                     /Fe+2

  3   6
3301403    21.6600    -0.5300                /CO2 (g)
5015001     8.4750     2.5850                /CALCITE
3028100     4.0080    30.8450                /HEMATITE
2802810    13.0320   -10.0000                /Fe+2/Fe+3
7015002   114.4000   -39.3900                /FCO3APATITE
7015003    44.1990     0.0000                /HYDRAPATITE
  6   3
      1     0.0000     0.0000                /E-1
3028000    -3.7370    50.4600                /MAGNETITE
5015002    17.0000     8.2900                /DOLOMITE
```

EQUILIBRATION OF GROUNDWATER (WC-5A) WITH WASTE BACKFILL MATERIAL
pCO2=10E-3.5, INFINITE CALCITE, HEMATITE, APATITE

Temperature (Celsius): 25.00
Units of concentration: MG/L
Ionic strength to be computed.
If specified, carbonate concentration represents total inorganic carbon.
Do not automatically terminate if charge imbalance exceeds 30%
Precipitation is allowed for all solids in the thermodynamic database and
the print option for solids is set to: 2
The maximum number of iterations is: 100
The method used to compute activity coefficients is: Davies equation
Intermediate output file

330	2.470E-05	-7.61	y
140	1.206E+02	-2.70	y
100	3.000E-02	-6.66	y
110	1.000E-03	-6.95	y
90	4.235E+00	-4.16	y
150	5.940E+01	-2.83	y
180	1.620E+02	-2.34	y
270	8.000E-01	-4.38	y
440	7.000E-02	-5.00	y
460	1.610E+01	-3.18	y
471	4.700E-01	-5.07	y
492	2.657E-01	-5.37	y
580	3.000E-02	-6.50	y
410	1.200E+01	-3.51	y
500	2.330E+02	-1.99	y
800	1.300E+00	-4.83	y
732	3.100E+02	-2.49	y
1	0.000E-01	-0.85	y
281	5.000E-01	-5.27	
280	1.000E-01	-5.27	

H2O has been inserted as a COMPONENT

3	6	
3301403	21.6600	-0.5300
5015001	8.4750	2.5850
3028100	4.0080	30.8450
2802810	13.0320	-10.0000
7015002	114.4000	-39.3900
7015003	44.1990	0.0000
6	3	
1	0.0000	0.0000
3028000	-3.7370	50.4600
5015002	17.0000	8.2900

INPUT DATA BEFORE TYPE MODIFICATIONS

ID	NAME	ACTIVITY GUESS	LOG GUESS	ANAL TOTAL
330	H+1	2.455E-08	-7.610	2.470E-05
140	CO3-2	1.995E-03	-2.700	1.206E+02
100	Ba+2	2.188E-07	-6.660	3.000E-02
110	Be+2	1.122E-07	-6.950	1.000E-03
90	H3BO3	6.918E-05	-4.160	4.235E+00
150	Ca+2	1.479E-03	-2.830	5.940E+01
180	Cl-1	4.571E-03	-2.340	1.620E+02
270	F-1	4.169E-05	-4.380	8.000E-01
440	Li+1	1.000E-05	-5.000	7.000E-02
460	Mg+2	6.607E-04	-3.180	1.610E+01
471	Mn+3	8.511E-06	-5.070	4.700E-01
492	NO3-1	4.266E-06	-5.370	2.657E-01
580	PO4-3	3.162E-07	-6.500	3.000E-02
410	K+1	3.090E-04	-3.510	1.200E+01
500	Na+1	1.023E-02	-1.990	2.330E+02
800	Sr+2	1.479E-05	-4.830	1.300E+00
732	SO4-2	3.236E-03	-2.490	3.100E+02
1	E-1	1.413E-01	-0.850	0.000E-01
281	Fe+3	5.370E-06	-5.270	5.000E-01
280	Fe+2	5.370E-06	-5.270	1.000E-01
2	H2O	1.000E+00	0.000	0.000E-01

Charge Balance: UNSPECIATED

Sum of CATIONS= 1.484E-02 Sum of ANIONS = 1.510E-02

PERCENT DIFFERENCE = 8.806E-01 (ANIONS - CATIONS)/(ANIONS + CATIONS)

IMPROVED ACTIVITY GUESSES PRIOR TO FIRST ITERATION:		
CO3-2	Log activity guess:	-6.44
PO4-3	Log activity guess:	-11.38
SO4-2	Log activity guess:	-2.49
Fe+2	Log activity guess:	-4.97
Fe+3	Log activity guess:	-18.01

PARAMETERS OF THE COMPONENT MOST OUT OF BALANCE:

ITER	NAME	TOTAL MOL	DIFF FXN	LOG ACTVTY	RESIDUAL
0	K+1	3.072E-04	8.872E-06	-3.51000	8.841E-06
1	K+1	3.072E-04	-6.362E-07	-3.53736	6.055E-07
2	K+1	3.072E-04	1.782E-05	-3.54485	1.779E-05
3	K+1	3.072E-04	2.905E-05	-3.56770	2.902E-05
4	Mg+2	-3.395E-03	-1.598E+06	-3.82065	1.598E+06
5	Mg+2	-3.395E-03	-6.406E+05	-3.91633	6.406E+05
6	Mg+2	-3.395E-03	-2.546E+05	-3.97881	2.545E+05
7	Mg+2	-3.395E-03	-1.005E+05	-4.01067	1.005E+05
8	Mg+2	-3.395E-03	-3.960E+04	-4.02570	3.959E+04
9	Mg+2	-3.395E-03	-1.558E+04	-4.03258	1.558E+04
10	Mg+2	-3.395E-03	-6.125E+03	-4.03569	6.125E+03
11	Mg+2	-3.395E-03	-2.408E+03	-4.03709	2.408E+03
12	Mg+2	-3.395E-03	-9.466E+02	-4.03771	9.465E+02
13	Mg+2	-3.395E-03	-3.721E+02	-4.03795	3.720E+02
14	Mg+2	-3.395E-03	-1.462E+02	-4.03795	1.462E+02
15	Mg+2	-3.395E-03	-5.745E+01	-4.03770	5.745E+01
16	Mg+2	-3.395E-03	-2.256E+01	-4.03694	2.256E+01
17	Mg+2	-3.395E-03	-8.844E+00	-4.03497	8.843E+00
18	Mg+2	-3.395E-03	-3.454E+00	-4.02998	3.453E+00
19	Mg+2	-3.395E-03	-1.337E+00	-4.01766	1.337E+00
20	Mg+2	-3.395E-03	-5.104E-01	-3.98846	5.103E-01
21	K+1	3.072E-04	-4.540E-08	-3.59691	1.469E-08
22	K+1	3.072E-04	-8.381E-08	-3.58974	5.309E-08
23	K+1	3.072E-04	-4.656E-08	-3.58434	1.584E-08
24	Mg+2	-3.395E-03	-6.506E-02	-3.56610	6.506E-02
25	Mg+2	-3.395E-03	-7.140E-02	-3.52083	7.139E-02
26	Mg+2	-3.395E-03	-7.056E-02	-3.51017	7.055E-02
27	Mg+2	-3.395E-03	-5.042E-02	-3.50894	5.041E-02
28	Mg+2	-3.395E-03	-2.201E-02	-3.50917	2.201E-02
29	Mg+2	-3.395E-03	-7.449E-03	-3.50928	7.448E-03
30	Mg+2	-3.395E-03	-2.126E-03	-3.50925	2.126E-03
31	Mg+2	-3.395E-03	-3.637E-04	-3.50924	3.632E-04
32	Mg+2	-3.395E-03	-1.655E-05	-3.50924	1.614E-05
34	K+1	3.072E-04	-5.682E-06	-3.58146	5.652E-06
35	K+1	3.072E-04	-1.256E-07	-3.57370	9.484E-08
36	Sr+2	1.485E-05	-1.730E-09	-5.05026	2.449E-10

ID	NAME	ANAL MOL	CALC MOL	LOG ACTVTY	GAMMA	DIFF FXN
330	H+1	2.453E-08	3.722E-09	-8.48474	0.880063	4.286E-08
732	SO4-2	3.230E-03	2.973E-03	-2.74868	0.599866	-8.382E-09
100	Ba+2	2.186E-07	2.186E-07	-6.88223	0.599866	-6.122E-13
110	Be+2	1.111E-07	1.111E-07	-7.17638	0.599866	-3.110E-13
90	H3BO3	6.855E-05	5.713E-05	-4.24154	1.003705	-5.268E-12
1	E-1	0.000E-01	2.283E+08	8.35856	0.880063	-4.048E-12
180	Cl-1	4.574E-03	4.574E-03	-2.39522	0.880063	-3.202E-09
270	F-1	4.215E-05	9.308E-08	-7.08664	0.880063	4.872E-08
440	Li+1	1.010E-05	1.002E-05	-5.05465	0.880063	-7.068E-12
460	Mg+2	6.628E-04	5.445E-04	-3.48596	0.599866	1.306E-09
471	Mn+3	8.563E-06	8.563E-06	-5.56675	0.316682	-5.395E-11
492	NO3-1	4.289E-06	4.289E-06	-5.42312	0.880063	-3.002E-12
800	Sr+2	1.485E-05	1.485E-05	-5.05021	0.599866	-4.158E-11
410	K+1	3.072E-04	3.034E-04	-3.57351	0.880063	-2.150E-10
140	CO3-2	2.012E-03	3.398E-05	-4.69069	0.599866	0.000E-01
580	PO4-3	3.162E-07	1.759E-11	-11.25413	0.316682	3.388E-21
2	H2O	-8.470E-22	-8.113E-04	-0.00017	1.000000	0.000E-01
150	Ca+2	1.483E-03	2.740E-04	-3.78423	0.599866	0.000E-01
280	Fe+2	1.792E-06	1.427E-06	-6.06740	0.599866	0.000E-01
281	Fe+3	8.961E-06	1.100E-27	-27.45796	0.316682	0.000E-01
500	Na+1	1.014E-02	1.004E-02	-2.05386	0.880063	1.592E-22

Type I - COMPONENTS AS SPECIES IN SOLUTION

ID	NAME	CALC MOL	ACTIVITY	LOG ACTVTY	GAMMA	NEW LOGK
330	H+1	3.722E-09	3.275E-09	-8.48474	0.88006	0.055
140	CO3-2	3.398E-05	2.038E-05	-4.69069	0.59987	0.222
100	Ba+2	2.186E-07	1.312E-07	-6.88223	0.59987	0.222
110	Be+2	1.111E-07	6.662E-08	-7.17638	0.59987	0.222
90	H3BO3	5.713E-05	5.734E-05	-4.24154	1.00370	-0.002
150	Ca+2	2.740E-04	1.643E-04	-3.78423	0.59987	0.222
180	Cl-1	4.574E-03	4.025E-03	-2.39522	0.88006	0.055
270	F-1	9.308E-08	8.191E-08	-7.08664	0.88006	0.055
440	Li+1	1.002E-05	8.818E-06	-5.05465	0.88006	0.055
460	Mg+2	5.445E-04	3.266E-04	-3.48596	0.59987	0.222
471	Mn+3	8.563E-06	2.712E-06	-5.56675	0.31668	0.499
492	NO3-1	4.289E-06	3.775E-06	-5.42312	0.88006	0.055
580	PO4-3	1.759E-11	5.570E-12	-11.25413	0.31668	0.499
410	K+1	3.034E-04	2.670E-04	-3.57351	0.88006	0.055
500	Na+1	1.004E-02	8.834E-03	-2.05386	0.88006	0.055
800	Sr+2	1.485E-05	8.908E-06	-5.05021	0.59987	0.222
732	SO4-2	2.973E-03	1.784E-03	-2.74868	0.59987	0.222
280	Fe+2	1.427E-06	8.563E-07	-6.06740	0.59987	0.222
281	Fe+3	1.100E-27	3.484E-28	-27.45796	0.31668	0.499

Type II - OTHER SPECIES IN SOLUTION OR ADSORBED

ID	NAME	CALC MOL	ACTIVITY	LOG ACTVTY	GAMMA	NEW LOGK
3305801	H2PO4 -	2.426E-09	2.135E-09	-8.67061	0.88006	19.608
3305802	H3PO4	9.774E-16	9.810E-16	-15.00834	1.00370	21.698
3300020	OH-	3.484E-06	3.066E-06	-5.51343	0.88006	-13.943
3300900	H2BO3 -1	1.143E-05	1.006E-05	-4.99761	0.88006	-9.185
902700	BF(OH)3 -	2.130E-12	1.874E-12	-11.72718	0.88006	-0.344
902701	BF2(OH)2 -	6.111E-20	5.378E-20	-19.26939	0.88006	7.685
902702	BF3OH -	1.786E-29	1.572E-29	-28.80361	0.88006	13.722
902703	BF4 -	1.939E-38	1.707E-38	-37.76782	0.88006	20.329
4603300	MgOH +	1.862E-07	1.639E-07	-6.78550	0.88006	-11.729
4602700	MgF +	2.009E-09	1.768E-09	-8.75260	0.88006	1.875
4601400	MgCO3 AQ	6.331E-06	6.354E-06	-5.19693	1.00370	2.978
4601401	MgHCO3 +	6.155E-06	5.417E-06	-5.26627	0.88006	11.451
4607320	MgSO4 AQ	1.032E-04	1.036E-04	-3.98464	1.00370	2.248
4605800	MgPO4 -	8.024E-09	7.062E-09	-8.15109	0.88006	6.644
4605801	MgH2PO4 +	2.582E-11	2.272E-11	-10.64357	0.88006	21.121
4605802	MgHPO4 AQ	9.853E-09	9.889E-09	-8.00483	1.00370	15.218
1503300	CaOH +	1.438E-08	1.266E-08	-7.89766	0.88006	-12.543
1501400	CaHCO3 +	2.760E-06	2.429E-06	-5.61457	0.88006	11.401
1501401	CaCO3 AQ	4.743E-06	4.761E-06	-5.32232	1.00370	3.151
1507320	CaSO4 AQ	5.949E-05	5.971E-05	-4.22392	1.00370	2.307
1505800	CaHPO4 AQ	3.633E-09	3.647E-09	-8.43810	1.00370	15.083
1505801	CaPO4 -	2.993E-09	2.634E-09	-8.57937	0.88006	6.514
1505802	CaH2PO4 +	1.018E-11	8.957E-12	-11.04784	0.88006	21.015
1502700	CaF +	1.332E-10	1.173E-10	-9.93088	0.88006	0.995
5001400	NaCO3 -	3.793E-06	3.338E-06	-5.47655	0.88006	1.323
5001401	NaHCO3 AQ	7.065E-06	7.091E-06	-5.14929	1.00370	10.078
5007320	NaSO4 -	8.973E-05	7.897E-05	-4.10254	0.88006	0.755
5005800	NaHPO4 -	7.921E-10	6.971E-10	-9.15673	0.88006	12.691
5002700	NaF AQ	1.169E-10	1.174E-10	-9.93050	1.00370	-0.792
4107320	KSO4 -	3.803E-06	3.347E-06	-5.47539	0.88006	0.902
4105800	KHPO4 -	2.416E-11	2.126E-11	-10.67238	0.88006	12.695
2803300	FeOH +	9.390E-08	8.264E-08	-7.08283	0.88006	-9.445
2803301	FeOH3 -1	2.766E-12	2.434E-12	-11.61369	0.88006	-30.945
2807320	FeSO4 AQ	2.706E-07	2.716E-07	-6.56608	1.00370	2.248
2805800	FeH2PO4 +	1.041E-12	9.162E-13	-12.03800	0.88006	22.308
2803302	FeOH2 AQ	2.139E-10	2.147E-10	-9.66826	1.00370	-20.572
2805801	FeHPO4 AQ	1.387E-10	1.392E-10	-9.85627	1.00370	15.948
2813300	FeOH +2	1.144E-21	6.865E-22	-21.16339	0.59987	-1.968
2815800	FeHPO4 +	4.352E-30	3.830E-30	-29.41683	0.88006	17.835
2817320	FeSO4 +	5.873E-27	5.168E-27	-26.28664	0.88006	3.975
2811800	FeCl +2	7.059E-29	4.235E-29	-28.37318	0.59987	1.702
2811801	FeCl2 +	8.651E-31	7.614E-31	-30.11841	0.88006	2.185
2811802	FeCl3 AQ	3.053E-34	3.065E-34	-33.51363	1.00370	1.128
2813301	FeOH2 +	7.883E-17	6.937E-17	-16.15882	0.88006	-5.615
2813302	FeOH3 AQ	2.478E-16	2.487E-16	-15.60425	1.00370	-13.602
2813303	FeOH4 -	8.626E-16	7.591E-16	-15.11968	0.88006	-21.545
2815801	FeH2PO4 +2	3.314E-31	1.988E-31	-30.70157	0.59987	25.202
2812700	FeF +2	7.522E-29	4.512E-29	-28.34560	0.59987	6.421
2812701	FeF2 +	1.676E-31	1.475E-31	-30.83124	0.88006	10.855

2812702	FeF3 AQ	1.908E-35	1.915E-35	-34.71788	1.00370	13.998
2817321	Fe(SO4)2 -	3.313E-28	2.915E-28	-27.53532	0.88006	5.475
2813304	Fe2(OH)2+4	9.795E-41	1.268E-41	-40.89678	0.12948	-2.062
2813305	Fe3(OH)4+5	4.483E-54	1.838E-55	-54.73560	0.04101	-4.913
4407320	LiSO4 -	7.801E-08	6.865E-08	-7.16334	0.88006	0.695
8003300	SrOH +	2.050E-10	1.805E-10	-9.74364	0.88006	-13.123
1003300	BaOH +	1.994E-12	1.755E-12	-11.75566	0.88006	-13.303
3301400	HCO3 -	1.620E-03	1.426E-03	-2.84587	0.88006	10.385
3301401	H2CO3 AQ	1.045E-05	1.049E-05	-4.97917	1.00370	16.679
3307320	HSO4 -	6.444E-10	5.671E-10	-9.24636	0.88006	2.043
3302700	HF AQ	3.945E-13	3.959E-13	-12.40238	1.00370	3.167
3302701	HF2 -	1.401E-19	1.233E-19	-18.90902	0.88006	3.804
3302702	H2F2 AQ	4.204E-25	4.219E-25	-24.37476	1.00370	6.766
3305800	HPO4 -2	6.746E-08	4.047E-08	-7.39287	0.59987	12.568

Type III - SPECIES WITH FIXED ACTIVITY

ID	NAME	CALC MOL	LOG MOL	NEW LOGK	DH
2	H2O	-8.113E-04	-3.091	0.000	0.000
7015003	HYDRAPATITE	-2.709E-05	-4.567	44.199	0.000
3301403	CO2 (g)	-8.212E-04	-3.086	21.660	-0.530
5015001	CALCITE	1.117E-03	-2.952	8.475	2.585
3028100	HEMATITE	4.481E-06	-5.349	4.008	30.845
2802810	Fe+2/Fe+3	-4.048E-12	-11.393	13.032	-10.000
7015002	FCO3APATITE	1.698E-05	-4.770	114.400	-39.390

Type V - POSSIBLE SOLIDS

ID	NAME	CALC MOL	LOG MOL	NEW LOGK	DH
4210000	BAF2	5.064E-16	-15.296	5.760	-1.000
5015000	ARAGONITE	7.263E-01	-0.139	8.336	2.615
6080000	CELESTITE	4.636E-02	-1.334	6.465	0.470
3028102	LEPIDOCROCIT	4.216E-04	-3.375	-1.371	0.000
6046000	EPSOMITE	8.020E-05	-4.096	2.140	-2.820
2028100	FERRIHYDRITE	1.273E-07	-6.895	-4.891	0.000
2028101	FE3(OH)8	4.691E-14	-13.329	-20.222	0.000
4128100	FEOH)2.7CL.3	5.913E-03	-2.228	3.040	0.000
6028100	FE2(SO4)3	0.000E-01	-66.742	-3.580	59.120
2046000	BRUCITE	4.911E-04	-3.309	-16.792	25.840
6010000	BARITE	2.214E+00	0.345	9.976	-6.280
4215000	FLUORITE	9.802E-08	-7.009	10.949	-4.710
2028102	GOETHITE	3.133E-03	-2.504	-0.500	14.480
6015001	GYPSUM	2.064E-02	-1.685	4.848	-0.261
4150000	HALITE	9.309E-07	-6.031	-1.582	-0.918
5046000	ARTINITE	5.082E-05	-4.294	-9.600	28.742
5015003	HUNTITE	9.186E-04	-3.037	29.968	25.760
5046001	HYDRMAGNESIT	3.483E-11	-10.458	8.766	52.210
6050000	JAROSITE NA	1.522E-28	-27.818	11.200	36.180
6041002	JAROSITE K	1.831E-26	-25.737	14.800	31.280
6028101	JAROSITE H	4.480E-34	-33.349	12.100	55.150
3028101	MAGHEMITE	4.036E-11	-10.394	-6.386	0.000
5046002	MAGNESITE	7.118E-01	-0.148	8.029	6.169
6015000	ANHYDRITE	1.271E-02	-1.896	4.637	3.769
6028000	MELANTERITE	4.495E-07	-6.347	2.470	-2.860
6050001	MIRABILITE	1.803E-06	-5.744	1.114	-18.987
3050000	NATRON	3.243E-08	-7.489	1.311	-15.745
5046003	NESQUEHONITE	2.779E-03	-2.556	5.621	5.789
5028000	SIDERITE	6.193E-01	-0.208	10.550	5.328
4280000	SRF2	2.073E-11	-10.683	8.540	-1.250
7028100	STRENGITE	4.871E-13	-12.312	26.400	2.030
5080000	STRONTIANITE	3.229E-01	-0.491	9.250	0.690
6050002	THENARDITE	2.102E-07	-6.677	0.179	0.572
5050001	THERMONATR	1.192E-09	-8.924	-0.125	2.802
7028001	VIVIANITE	1.942E-05	-4.712	36.000	0.000
5010000	WITHERITE	1.028E-03	-2.988	8.585	-0.360
2047000	PYROLUSITE	1.420E+04	4.152	-15.861	29.180
2047001	BIRNESSITE	8.362E+01	1.922	-18.091	0.000
2047002	NSUTITE	3.231E+02	2.509	-17.504	0.000
3047100	BIXBYITE	0.000E-01	40.385	0.611	15.245
2047100	MANGANITE	1.334E+20	20.125	0.238	0.000
6047100	MN2(SO4)3	2.145E-14	-13.669	5.711	39.060

2015000	LIME	2.444E-20	-19.612	-32.797	46.265
2015001	PORTLANDITE	3.235E-10	-9.490	-22.675	30.690
2028000	WUSTITE	3.439E-01	-0.464	-11.687	24.846
2046001	PERICLASE	9.405E-09	-8.027	-21.510	36.135
3046001	MAG-FERRITE	5.133E-08	-7.290	-16.765	66.639

Type VI - EXCLUDED SPECIES (not included in mole balance)

ID	NAME	CALC MOL	LOG MOL	NEW LOGK	DH
5015002	DOLOMITE	2.231E+00	0.348	17.000	8.290
3028000	MAGNETITE	1.435E+03	3.157	-3.737	50.460
1	E-1	2.283E+08	8.359	0.000	0.000
3301404	CH4 (g)	2.697E+17	17.431	40.100	-61.000
3300021	O2 (g)	0.000E-01	-82.616	-83.120	133.830

PERCENTAGE DISTRIBUTION OF COMPONENTS AMONG
TYPE I and TYPE II (dissolved and adsorbed) species

H+1		98.7	PERCENT BOUND IN SPECIES #3301400	HCO3 -	
	1.3	PERCENT BOUND IN SPECIES #3301401	H2CO3 AQ		
SO4-2		92.1	PERCENT BOUND IN SPECIES # 732	SO4-2	
	3.2	PERCENT BOUND IN SPECIES #4607320	MgSO4 AQ		
	1.8	PERCENT BOUND IN SPECIES #1507320	CaSO4 AQ		
	2.8	PERCENT BOUND IN SPECIES #5007320	NaSO4 -		
Ba+2		100.0	PERCENT BOUND IN SPECIES # 100	Ba+2	
Be+2		100.0	PERCENT BOUND IN SPECIES # 110	Be+2	
H3BO3		83.3	PERCENT BOUND IN SPECIES # 90	H3BO3	
	16.7	PERCENT BOUND IN SPECIES #3300900	H2BO3 -1		
E-1					
Cl-1		100.0	PERCENT BOUND IN SPECIES # 180	Cl-1	
F-1		97.6	PERCENT BOUND IN SPECIES # 270	F-1	
	2.1	PERCENT BOUND IN SPECIES #4602700	MgF +		
Li+1		99.2	PERCENT BOUND IN SPECIES # 440	Li+1	
Mg+2		82.4	PERCENT BOUND IN SPECIES # 460	Mg+2	
	15.6	PERCENT BOUND IN SPECIES #4607320	MgSO4 AQ		
Mn+3		100.0	PERCENT BOUND IN SPECIES # 471	Mn+3	
NO3-1		100.0	PERCENT BOUND IN SPECIES # 492	NO3-1	
Sr+2		100.0	PERCENT BOUND IN SPECIES # 800	Sr+2	
K+1		98.8	PERCENT BOUND IN SPECIES # 410	K+1	
	1.2	PERCENT BOUND IN SPECIES #4107320	KSO4 -		
CO3-2		2.0	PERCENT BOUND IN SPECIES # 140	CO3-2	
	95.6	PERCENT BOUND IN SPECIES #3301400	HCO3 -		
PO4-3		2.5	PERCENT BOUND IN SPECIES #3305801	H2PO4 -	
	8.4	PERCENT BOUND IN SPECIES #4605800	MgPO4 -		
	10.3	PERCENT BOUND IN SPECIES #4605802	MgHPO4 AQ		
	3.8	PERCENT BOUND IN SPECIES #1505800	CaHPO4 AQ		
	3.1	PERCENT BOUND IN SPECIES #1505801	CaPO4 -		
	70.7	PERCENT BOUND IN SPECIES #3305800	HPO4 -2		
H2O		92.2	PERCENT BOUND IN SPECIES #3300020	OH-	
	4.9	PERCENT BOUND IN SPECIES #4603300	MgOH +		
	2.5	PERCENT BOUND IN SPECIES #2803300	FeOH +		
Ca+2		80.3	PERCENT BOUND IN SPECIES # 150	Ca+2	
	1.4	PERCENT BOUND IN SPECIES #1501401	CaCO3 AQ		
	17.4	PERCENT BOUND IN SPECIES #1507320	CaSO4 AQ		
Fe+2		79.6	PERCENT BOUND IN SPECIES # 280	Fe+2	
	5.2	PERCENT BOUND IN SPECIES #2803300	FeOH +		
	15.1	PERCENT BOUND IN SPECIES #2807320	FeSO4 AQ		
Fe+3		6.6	PERCENT BOUND IN SPECIES #2813301	FeOH2 +	
	20.8	PERCENT BOUND IN SPECIES #2813302	FeOH3 AQ		
	72.5	PERCENT BOUND IN SPECIES #2813303	FeOH4 -		
Na+1		99.0	PERCENT BOUND IN SPECIES # 500	Na+1	

---------- PROVISIONAL MASS DISTRIBUTION ----------

IDX	NAME	DISSOLVED		SORBED		PRECIPITATED	
		MOL/KG	PERCENT	MOL/KG	PERCENT	MOL/KG	PERCENT
330	H+1	1.642E-03	100.0	0.000E-01	0.0	0.000E-01	0.0
732	SO4-2	3.230E-03	100.0	0.000E-01	0.0	0.000E-01	0.0
100	Ba+2	2.186E-07	100.0	0.000E-01	0.0	0.000E-01	0.0
110	Be+2	1.111E-07	100.0	0.000E-01	0.0	0.000E-01	0.0
90	H3BO3	6.855E-05	100.0	0.000E-01	0.0	0.000E-01	0.0
1	E-1	0.000E-01	0.0	0.000E-01	0.0	0.000E-01	0.0
180	Cl-1	4.574E-03	100.0	0.000E-01	0.0	0.000E-01	0.0
270	F-1	9.534E-08	100.0	0.000E-01	0.0	0.000E-01	0.0
440	Li+1	1.010E-05	100.0	0.000E-01	0.0	0.000E-01	0.0
460	Mg+2	6.604E-04	100.0	0.000E-01	0.0	0.000E-01	0.0
471	Mn+3	8.563E-06	100.0	0.000E-01	0.0	0.000E-01	0.0
492	NO3-1	4.289E-06	100.0	0.000E-01	0.0	0.000E-01	0.0
800	Sr+2	1.485E-05	100.0	0.000E-01	0.0	0.000E-01	0.0
410	K+1	3.072E-04	100.0	0.000E-01	0.0	0.000E-01	0.0
140	CO3-2	1.696E-03	100.0	0.000E-01	0.0	0.000E-01	0.0
580	PO4-3	9.540E-08	100.0	0.000E-01	0.0	0.000E-01	0.0
2	H2O	3.779E-06	100.0	0.000E-01	0.0	0.000E-01	0.0
150	Ca+2	3.410E-04	100.0	0.000E-01	0.0	0.000E-01	0.0
280	Fe+2	1.792E-06	100.0	0.000E-01	0.0	0.000E-01	0.0
281	Fe+3	1.189E-15	100.0	0.000E-01	0.0	0.000E-01	0.0
500	Na+1	1.014E-02	100.0	0.000E-01	0.0	0.000E-01	0.0

Charge Balance: SPECIATED

Sum of CATIONS = 1.206E-02 Sum of ANIONS 1.233E-02

PERCENT DIFFERENCE = 1.106E+00 (ANIONS - CATIONS)/(ANIONS + CATIONS)

PROVISIONAL IONIC STRENGTH (m) = 1.606E-02

PART 6 of OUTPUT FILE

PC MINTEQA2 v3.10 DATE OF CALCULATIONS: 25-SEP-96 TIME: 11:19:47

Saturation indices and stoichiometry of all supersaturated minerals

ID #	NAME	Sat. Index	Stoichiometry in [brackets]
6010000	BARITE	0.345	[1.000] 100 [1.000] 732
5015001	CALCITE	0.000	[1.000] 150 [1.000] 140
5015002	DOLOMITE	0.348	[1.000] 150 [1.000] 460 [2.000] 140
7015003	HYDRAPATITE	0.000	[5.000] 150 [3.000] 580 [1.000] 2
			[-1.000] 330
7015002	FCO3APATITE	0.000	[9.496] 150 [0.360] 500 [0.144] 460
			[4.800] 580 [1.200] 140 [2.480] 270
3028100	HEMATITE	0.000	[-6.000] 330 [2.000] 281 [3.000] 2
3028000	MAGNETITE	3.157	[-8.000] 330 [2.000] 281 [1.000] 280
			[4.000] 2
2047000	PYROLUSITE	4.152	[-4.000] 330 [-1.000] 1 [1.000] 471
			[2.000] 2
2047001	BIRNESSITE	1.922	[-4.000] 330 [-1.000] 1 [1.000] 471
			[2.000] 2
2047002	NSUTITE	2.509	[-4.000] 330 [-1.000] 1 [1.000] 471
			[2.000] 2
3047100	BIXBYITE	40.385	[-6.000] 330 [2.000] 471 [3.000] 2
2047100	MANGANITE	20.125	[-3.000] 330 [1.000] 471 [2.000] 2

PC MINTEQA2 v3.10 DATE OF CALCULATIONS: 25-SEP-96 TIME: 11:19:48

ITERATIONS= 37: SOLID BIXBYITE PRECIPITATES

PARAMETERS OF THE COMPONENT MOST OUT OF BALANCE:

ITER	NAME	TOTAL MOL	DIFF FXN	LOG ACTVTY	RESIDUAL
37	Sr+2	1.485E-05	-5.942E-06	-5.05021	5.941E-06
38	Sr+2	1.485E-05	9.647E-06	-4.82827	9.645E-06
39	Sr+2	1.485E-05	1.881E-07	-5.04566	1.866E-07
40	Sr+2	1.485E-05	-3.726E-08	-5.05112	3.577E-08
41	Sr+2	1.485E-05	-1.783E-09	-5.05003	2.984E-10

ID	NAME	ANAL MOL	CALC MOL	LOG ACTVTY	GAMMA	DIFF FXN
330	H+1	2.453E-08	3.752E-09	-8.48120	0.880181	4.500E-08
732	SO4-2	3.230E-03	2.972E-03	-2.74861	0.600189	-8.804E-09
100	Ba+2	2.186E-07	2.186E-07	-6.88199	0.600189	-6.432E-13
110	Be+2	1.111E-07	1.111E-07	-7.17614	0.600189	-3.267E-13
90	H3BO3	6.855E-05	5.721E-05	-4.24095	1.003695	-5.478E-12
1	E-1	0.000E-01	2.230E+08	8.34833	0.880181	-4.253E-12
180	Cl-1	4.574E-03	4.574E-03	-2.39517	0.880181	-3.364E-09
270	F-1	4.215E-05	9.239E-08	-7.08979	0.880181	5.119E-08
440	Li+1	1.010E-05	1.002E-05	-5.05460	0.880181	-7.426E-12
460	Mg+2	6.628E-04	5.445E-04	-3.48568	0.600189	1.372E-09
410	K+1	3.072E-04	3.034E-04	-3.57346	0.880181	-2.259E-10
492	NO3-1	4.289E-06	4.289E-06	-5.42306	0.880181	-3.154E-12
800	Sr+2	1.485E-05	1.485E-05	-5.04998	0.600189	-4.369E-11
471	Mn+3	8.563E-06	5.623E-26	-25.74886	0.317064	6.353E-21
580	PO4-3	3.162E-07	1.714E-11	-11.26473	0.317064	-1.522E-21
140	CO3-2	2.012E-03	3.342E-05	-4.69776	0.600189	0.000E-01
500	Na+1	1.014E-02	1.004E-02	-2.05380	0.880181	-3.180E-21
281	Fe+3	8.961E-06	1.126E-27	-27.44736	0.317064	0.000E-01
280	Fe+2	1.792E-06	1.428E-06	-6.06703	0.600189	0.000E-01
150	Ca+2	1.483E-03	2.783E-04	-3.77717	0.600189	1.519E-20
2	H2O	-8.470E-22	-8.046E-04	-0.00017	1.000000	8.470E-22

Type I - COMPONENTS AS SPECIES IN SOLUTION

ID	NAME	CALC MOL	ACTIVITY	LOG ACTVTY	GAMMA	NEW LOGK
330	H+1	3.752E-09	3.302E-09	-8.48120	0.88018	0.055
140	CO3-2	3.342E-05	2.006E-05	-4.69776	0.60019	0.222
100	Ba+2	2.186E-07	1.312E-07	-6.88199	0.60019	0.222
110	Be+2	1.111E-07	6.666E-08	-7.17614	0.60019	0.222
90	H3BO3	5.721E-05	5.742E-05	-4.24095	1.00370	-0.002
150	Ca+2	2.783E-04	1.670E-04	-3.77717	0.60019	0.222
180	Cl-1	4.574E-03	4.026E-03	-2.39517	0.88018	0.055
270	F-1	9.239E-08	8.132E-08	-7.08979	0.88018	0.055
440	Li+1	1.002E-05	8.819E-06	-5.05460	0.88018	0.055
460	Mg+2	5.445E-04	3.268E-04	-3.48568	0.60019	0.222
471	Mn+3	5.623E-26	1.783E-26	-25.74886	0.31706	0.499
492	NO3-1	4.289E-06	3.775E-06	-5.42306	0.88018	0.055
580	PO4-3	1.714E-11	5.436E-12	-11.26473	0.31706	0.499
410	K+1	3.034E-04	2.670E-04	-3.57346	0.88018	0.055
500	Na+1	1.004E-02	8.835E-03	-2.05380	0.88018	0.055
800	Sr+2	1.485E-05	8.913E-06	-5.04998	0.60019	0.222
732	SO4-2	2.972E-03	1.784E-03	-2.74861	0.60019	0.222
280	Fe+2	1.428E-06	8.570E-07	-6.06704	0.60019	0.222
281	Fe+3	1.126E-27	3.570E-28	-27.44736	0.31706	0.499

Type II - OTHER SPECIES IN SOLUTION OR ADSORBED

ID	NAME	CALC MOL	ACTIVITY	LOG ACTVTY	GAMMA	NEW LOGK
3305801	H2PO4 -	2.406E-09	2.118E-09	-8.67414	0.88018	19.608
3305802	H3PO4	9.774E-16	9.810E-16	-15.00834	1.00370	21.698
3300020	OH-	3.455E-06	3.041E-06	-5.51696	0.88018	-13.943
3300900	H2BO3 -1	1.135E-05	9.987E-06	-5.00055	0.88018	-9.185
902700	BF(OH)3 -	2.117E-12	1.863E-12	-11.72974	0.88018	-0.344

902701	BF2(OH)2 -	6.079E-20	5.351E-20	-19.27156	0.88018	7.685
902702	BF3OH -	1.778E-29	1.565E-29	-28.80539	0.88018	13.722
902703	BF4 -	1.933E-38	1.701E-38	-37.76921	0.88018	20.329
4603300	MgOH +	1.848E-07	1.626E-07	-6.78875	0.88018	-11.729
4602700	MgF +	1.995E-09	1.756E-09	-8.75547	0.88018	1.875
4601400	MgCO3 AQ	6.233E-06	6.256E-06	-5.20371	1.00370	2.978
4601401	MgHCO3 +	6.108E-06	5.376E-06	-5.26952	0.88018	11.451
4607320	MgSO4 AQ	1.033E-04	1.037E-04	-3.98429	1.00370	2.248
4605800	MgPO4 -	7.835E-09	6.896E-09	-8.16141	0.88018	6.644
4605801	MgH2PO4 +	2.562E-11	2.255E-11	-10.64682	0.88018	21.121
4605802	MgHPO4 AQ	9.700E-09	9.736E-09	-8.01161	1.00370	15.218
1503300	CaOH +	1.450E-08	1.276E-08	-7.89413	0.88018	-12.543
1501400	CaHCO3 +	2.782E-06	2.449E-06	-5.61104	0.88018	11.401
1501401	CaCO3 AQ	4.743E-06	4.761E-06	-5.32232	1.00370	3.151
1507320	CaSO4 AQ	6.048E-05	6.070E-05	-4.21678	1.00370	2.307
1505800	CaHPO4 AQ	3.633E-09	3.647E-09	-8.43810	1.00370	15.083
1505801	CaPO4 -	2.968E-09	2.613E-09	-8.58290	0.88018	6.514
1505802	CaH2PO4 +	1.026E-11	9.030E-12	-11.04431	0.88018	21.015
1502700	CaF +	1.344E-10	1.183E-10	-9.92696	0.88018	0.995
5001400	NaCO3 -	3.731E-06	3.284E-06	-5.48356	0.88018	1.323
5001401	NaHCO3 AQ	7.008E-06	7.034E-06	-5.15277	1.00370	10.078
5007320	NaSO4 -	8.975E-05	7.899E-05	-4.10240	0.88018	0.755
5005800	NaHPO4 -	7.793E-10	6.859E-10	-9.16373	0.88018	12.691
5002700	NaF AQ	1.161E-10	1.165E-10	-9.93358	1.00370	-0.792
4107320	KSO4 -	3.803E-06	3.348E-06	-5.47526	0.88018	0.902
4105800	KHPO4 -	2.377E-11	2.092E-11	-10.67939	0.88018	12.695
2803300	FeOH +	9.320E-08	8.204E-08	-7.08600	0.88018	-9.445
2803301	FeOH3 -1	2.701E-12	2.377E-12	-11.62392	0.88018	-30.945
2807320	FeSO4 AQ	2.709E-07	2.719E-07	-6.56564	1.00370	2.248
2805800	FeH2PO4 +	1.033E-12	9.096E-13	-12.04117	0.88018	22.308
2803302	FeOH2 AQ	2.106E-10	2.114E-10	-9.67496	1.00370	-20.572
2805801	FeHPO4 AQ	1.366E-10	1.371E-10	-9.86297	1.00370	15.948
2813300	FeOH +2	1.162E-21	6.977E-22	-21.15633	0.60019	-1.968
2815800	FeHPO4 +	4.387E-30	3.861E-30	-29.41330	0.88018	17.835
2817320	FeSO4 +	6.018E-27	5.297E-27	-26.27597	0.88018	3.975
2811800	FeCl +2	7.231E-29	4.340E-29	-28.36253	0.60019	1.702
2811801	FeCl2 +	8.866E-31	7.804E-31	-30.10770	0.88018	2.185
2811802	FeCl3 AQ	3.130E-34	3.142E-34	-33.50286	1.00370	1.128
2813301	FeOH2 +	7.946E-17	6.994E-17	-16.15529	0.88018	-5.615
2813302	FeOH3 AQ	2.478E-16	2.487E-16	-15.60425	1.00370	-13.602
2813303	FeOH4 -	8.555E-16	7.530E-16	-15.12321	0.88018	-21.545
2815801	FeH2PO4 +2	3.367E-31	2.021E-31	-30.69450	0.60019	25.202
2812700	FeF +2	7.648E-29	4.590E-29	-28.33815	0.60019	6.421
2812701	FeF2 +	1.692E-31	1.490E-31	-30.82694	0.88018	10.855
2812702	FeF3 AQ	1.913E-35	1.920E-35	-34.71673	1.00370	13.998
2817321	Fe(SO4)2 -	3.395E-28	2.988E-28	-27.52458	0.88018	5.475
2813304	Fe2(OH)2+4	1.010E-40	1.310E-41	-40.88265	0.12976	-2.063
2813305	Fe3(OH)4+5	4.653E-54	1.915E-55	-54.71794	0.04114	-4.914
4407320	LiSO4 -	7.802E-08	6.867E-08	-7.16320	0.88018	0.695
8003300	SrOH +	2.035E-10	1.791E-10	-9.74694	0.88018	-13.123
1003300	BaOH +	1.979E-12	1.742E-12	-11.75896	0.88018	-13.303
3301400	HCO3 -	1.607E-03	1.414E-03	-2.84940	0.88018	10.385
3301401	H2CO3 AQ	1.045E-05	1.049E-05	-4.97917	1.00370	16.679
3307320	HSO4 -	6.496E-10	5.718E-10	-9.24275	0.88018	2.042
3302700	HF AQ	3.948E-13	3.963E-13	-12.40199	1.00370	3.167
3302701	HF2 -	1.392E-19	1.225E-19	-18.91178	0.88018	3.804
3302702	H2F2 AQ	4.211E-25	4.227E-25	-24.37398	1.00370	6.766
3305800	HPO4 -2	6.634E-08	3.982E-08	-7.39994	0.60019	12.568

Type III - SPECIES WITH FIXED ACTIVITY

ID	NAME	CALC MOL	LOG MOL	NEW LOGK	DH
2	H2O	-8.046E-04	-3.094	0.000	0.000
7015003	HYDRAPATITE	-2.709E-05	-4.567	44.199	0.000
3301403	CO2 (g)	-8.016E-04	-3.096	21.660	-0.530
5015001	CALCITE	1.111E-03	-2.954	8.475	2.585
3028100	HEMATITE	4.481E-06	-5.349	4.008	30.845
2802810	Fe+2/Fe+3	-4.253E-12	-11.371	13.032	-10.000
7015002	FCO3APATITE	1.698E-05	-4.770	114.400	-39.390

Type IV - FINITE SOLIDS (presumed present at equilibrium)

ID	NAME	CALC MOL	LOG MOL	NEW LOGK	DH
3047100	BIXBYITE	4.281E-06	-5.368	0.611	15.245

Type V - POSSIBLE SOLIDS

ID	NAME	CALC MOL	LOG MOL	NEW LOGK	DH
5015000	ARAGONITE	7.263E-01	-0.139	8.336	2.615
6080000	CELESTITE	4.639E-02	-1.334	6.465	0.470
3028102	LEPIDOCROCIT	4.216E-04	-3.375	-1.371	0.000
6046000	EPSOMITE	8.027E-05	-4.095	2.140	-2.820
2028100	FERRIHYDRITE	1.273E-07	-6.895	-4.891	0.000
2028101	FE3(OH)8	4.619E-14	-13.335	-20.222	0.000
4128100	FEOH)2.7CL.3	5.928E-03	-2.227	3.040	0.000
6028100	FE2(SO4)3	0.000E-01	-66.721	-3.580	59.120
2046000	BRUCITE	4.835E-04	-3.316	-16.792	25.840
6010000	BARITE	2.215E+00	0.345	9.976	-6.280
4215000	FLUORITE	9.819E-08	-7.008	10.949	-4.710
2028102	GOETHITE	3.133E-03	-2.504	-0.500	14.480
6015001	GYPSUM	2.098E-02	-1.678	4.848	-0.261
4150000	HALITE	9.312E-07	-6.031	-1.582	-0.918
5046000	ARTINITE	4.926E-05	-4.308	-9.600	28.742
5015003	HUNTITE	8.765E-04	-3.057	29.968	25.760
5046001	HYDRMAGNESIT	3.221E-11	-10.492	8.766	52.210
6050000	JAROSITE NA	1.560E-28	-27.807	11.200	36.180
6041002	JAROSITE K	1.877E-26	-25.727	14.800	31.280
6028101	JAROSITE H	4.630E-34	-33.334	12.100	55.150
3028101	MAGHEMITE	4.036E-11	-10.394	-6.386	0.000
5046002	MAGNESITE	7.008E-01	-0.154	8.029	6.169
6015000	ANHYDRITE	1.292E-02	-1.889	4.637	3.769
6028000	MELANTERITE	4.500E-07	-6.347	2.470	-2.860
6050001	MIRABILITE	1.804E-06	-5.744	1.114	-18.987
3050000	NATRON	3.191E-08	-7.496	1.311	-15.745
5046003	NESQUEHONITE	2.736E-03	-2.563	5.621	5.789
5028000	SIDERITE	6.098E-01	-0.215	10.550	5.328
4280000	SRF2	2.044E-11	-10.690	8.540	-1.250
7028100	STRENGITE	4.871E-13	-12.312	26.400	2.030
5080000	STRONTIANITE	3.179E-01	-0.498	9.250	0.690
6050002	THENARDITE	2.103E-07	-6.677	0.179	0.572
5050001	THERMONATR	1.173E-09	-8.931	-0.125	2.802
7028001	VIVIANITE	1.854E-05	-4.732	36.000	0.000
5010000	WITHERITE	1.012E-03	-2.995	8.585	-0.360
2047000	PYROLUSITE	9.253E-17	-16.034	-15.861	29.180
2047001	BIRNESSITE	5.449E-19	-18.264	-18.091	0.000
2047002	NSUTITE	2.105E-18	-17.677	-17.504	0.000
4210000	BAF2	4.994E-16	-15.302	5.760	-1.000
2047100	MANGANITE	8.559E-01	-0.068	0.238	0.000
6047100	MN2(SO4)3	0.000E-01	-54.033	5.711	39.060
2015000	LIME	2.444E-20	-19.612	-32.797	46.265
2015001	PORTLANDITE	3.235E-10	-9.490	-22.675	30.690
2028000	WUSTITE	3.387E-01	-0.470	-11.687	24.846
2046001	PERICLASE	9.259E-09	-8.033	-21.510	36.135
3046001	MAG-FERRITE	5.053E-08	-7.296	-16.765	66.639

Type VI - EXCLUDED SPECIES (not included in mole balance)

ID	NAME	CALC MOL	LOG MOL	NEW LOGK	DH
5015002	DOLOMITE	2.196E+00	0.342	17.000	8.290
3028000	MAGNETITE	1.413E+03	3.150	-3.737	50.460
1	E-1	2.230E+08	8.348	0.000	0.000
3301404	CH4 (g)	2.384E+17	17.377	40.100	-61.000
3300021	O2 (g)	0.000E-01	-82.589	-83.120	133.830

PERCENTAGE DISTRIBUTION OF COMPONENTS AMONG
TYPE I and TYPE II (dissolved and adsorbed) species

H+1		98.7	PERCENT BOUND IN SPECIES	#3301400	HCO3 -
	1.3	PERCENT BOUND IN SPECIES	#3301401	H2CO3 AQ	
SO4-2		92.0	PERCENT BOUND IN SPECIES	# 732	SO4-2
	3.2	PERCENT BOUND IN SPECIES	#4607320	MgSO4 AQ	
	1.9	PERCENT BOUND IN SPECIES	#1507320	CaSO4 AQ	
	2.8	PERCENT BOUND IN SPECIES	#5007320	NaSO4 -	
Ba+2		100.0	PERCENT BOUND IN SPECIES	# 100	Ba+2
Be+2		100.0	PERCENT BOUND IN SPECIES	# 110	Be+2
H3BO3		83.4	PERCENT BOUND IN SPECIES	# 90	H3BO3
	16.6	PERCENT BOUND IN SPECIES	#3300900	H2BO3 -1	
E-1					
Cl-1		100.0	PERCENT BOUND IN SPECIES	# 180	Cl-1
F-1		97.6	PERCENT BOUND IN SPECIES	# 270	F-1
	2.1	PERCENT BOUND IN SPECIES	#4602700	MgF +	
Li+1		99.2	PERCENT BOUND IN SPECIES	# 440	Li+1
Mg+2		82.5	PERCENT BOUND IN SPECIES	# 460	Mg+2
	15.6	PERCENT BOUND IN SPECIES	#4607320	MgSO4 AQ	
K+1		98.8	PERCENT BOUND IN SPECIES	# 410	K+1
	1.2	PERCENT BOUND IN SPECIES	#4107320	KSO4 -	
NO3-1		100.0	PERCENT BOUND IN SPECIES	# 492	NO3-1
Sr+2		100.0	PERCENT BOUND IN SPECIES	# 800	Sr+2
Mn+3		100.0	PERCENT BOUND IN SPECIES	# 471	Mn+3
PO4-3		2.6	PERCENT BOUND IN SPECIES	#3305801	H2PO4 -
	8.3	PERCENT BOUND IN SPECIES	#4605800	MgPO4 -	
	10.3	PERCENT BOUND IN SPECIES	#4605802	MgHPO4 AQ	
	3.9	PERCENT BOUND IN SPECIES	#1505800	CaHPO4 AQ	
	3.2	PERCENT BOUND IN SPECIES	#1505801	CaPO4 -	
	70.7	PERCENT BOUND IN SPECIES	#3305800	HPO4 -2	
CO3-2		2.0	PERCENT BOUND IN SPECIES	# 140	CO3-2
	95.6	PERCENT BOUND IN SPECIES	#3301400	HCO3 -	
Na+1		99.0	PERCENT BOUND IN SPECIES	# 500	Na+1
Fe+3		6.7	PERCENT BOUND IN SPECIES	#2813301	FeOH2 +
	21.0	PERCENT BOUND IN SPECIES	#2813302	FeOH3 AQ	
	72.3	PERCENT BOUND IN SPECIES	#2813303	FeOH4 -	
Fe+2		79.7	PERCENT BOUND IN SPECIES	# 280	Fe+2
	5.2	PERCENT BOUND IN SPECIES	#2803300	FeOH +	
	15.1	PERCENT BOUND IN SPECIES	#2807320	FeSO4 AQ	
Ca+2		80.4	PERCENT BOUND IN SPECIES	# 150	Ca+2
	1.4	PERCENT BOUND IN SPECIES	#1501401	CaCO3 AQ	
	17.5	PERCENT BOUND IN SPECIES	#1507320	CaSO4 AQ	
H2O		92.2	PERCENT BOUND IN SPECIES	#3300020	OH-
	4.9	PERCENT BOUND IN SPECIES	#4603300	MgOH +	
	2.5	PERCENT BOUND IN SPECIES	#2803300	FeOH +	

---------- PROVISIONAL MASS DISTRIBUTION ----------

IDX	NAME	DISSOLVED		SORBED		PRECIPITATED	
		MOL/KG	PERCENT	MOL/KG	PERCENT	MOL/KG	PERCENT
330	H+1	1.629E-03	100.0	0.000E-01	0.0	0.000E-01	0.0
732	SO4-2	3.230E-03	100.0	0.000E-01	0.0	0.000E-01	0.0
100	Ba+2	2.186E-07	100.0	0.000E-01	0.0	0.000E-01	0.0
110	Be+2	1.111E-07	100.0	0.000E-01	0.0	0.000E-01	0.0
90	H3BO3	6.855E-05	100.0	0.000E-01	0.0	0.000E-01	0.0
1	E-1	0.000E-01	0.0	0.000E-01	0.0	0.000E-01	0.0
180	Cl-1	4.574E-03	100.0	0.000E-01	0.0	0.000E-01	0.0
270	F-1	9.464E-08	100.0	0.000E-01	0.0	0.000E-01	0.0
440	Li+1	1.010E-05	100.0	0.000E-01	0.0	0.000E-01	0.0
460	Mg+2	6.604E-04	100.0	0.000E-01	0.0	0.000E-01	0.0
410	K+1	3.072E-04	100.0	0.000E-01	0.0	0.000E-01	0.0
492	NO3-1	4.289E-06	100.0	0.000E-01	0.0	0.000E-01	0.0
800	Sr+2	1.485E-05	100.0	0.000E-01	0.0	0.000E-01	0.0
471	Mn+3	5.623E-26	0.0	0.000E-01	0.0	8.563E-06	100.0
580	PO4-3	9.388E-08	100.0	0.000E-01	0.0	0.000E-01	0.0
140	CO3-2	1.682E-03	100.0	0.000E-01	0.0	0.000E-01	0.0
500	Na+1	1.014E-02	100.0	0.000E-01	0.0	0.000E-01	0.0
281	Fe+3	1.183E-15	100.0	0.000E-01	0.0	0.000E-01	0.0
280	Fe+2	1.792E-06	100.0	0.000E-01	0.0	0.000E-01	0.0
150	Ca+2	3.463E-04	100.0	0.000E-01	0.0	0.000E-01	0.0
2	H2O	3.748E-06	100.0	0.000E-01	0.0	0.000E-01	0.0

Charge Balance: SPECIATED

Sum of CATIONS = 1.204E-02 Sum of ANIONS 1.231E-02

PERCENT DIFFERENCE = 1.108E+00 (ANIONS - CATIONS)/(ANIONS + CATIONS)

PROVISIONAL IONIC STRENGTH (m) = 1.602E-02

Saturation indices and stoichiometry of all supersaturated minerals

ID #	NAME	Sat. Index	Stoichiometry in [brackets]
6010000	BARITE	0.345	[1.000] 100 [1.000] 732
5015001	CALCITE	0.000	[1.000] 150 [1.000] 140
5015002	DOLOMITE	0.342	[1.000] 150 [1.000] 460 [2.000] 140
7015002	FCO3APATITE	0.000	[9.496] 150 [0.360] 500 [0.144] 460
			[4.800] 580 [1.200] 140 [2.480] 270
3028100	HEMATITE	0.000	[-6.000] 330 [2.000] 281 [3.000] 2
3028000	MAGNETITE	3.150	[-8.000] 330 [2.000] 281 [1.000] 280
			[4.000] 2
3047100	BIXBYITE	0.000	[-6.000] 330 [2.000] 471 [3.000] 2

PC MINTEQA2 v3.10 DATE OF CALCULATIONS: 25-SEP-96 TIME: 11:19:49

ITERATIONS= 42: SOLID BARITE PRECIPITATES

PART 3 of OUTPUT FILE

PC MINTEQA2 v3.10 DATE OF CALCULATIONS: 25-SEP-96 TIME: 11:19:50

PARAMETERS OF THE COMPONENT MOST OUT OF BALANCE:

ITER	NAME	TOTAL MOL	DIFF FXN	LOG ACTVTY	RESIDUAL
42	NO3-1	4.289E-06	-5.139E-07	-5.42306	5.135E-07
43	NO3-1	4.289E-06	5.717E-07	-5.36763	5.712E-07
44	NO3-1	4.289E-06	1.355E-08	-5.42198	1.312E-08
45	NO3-1	4.289E-06	-2.690E-09	-5.42335	2.262E-09
46	Be+2	1.111E-07	-1.334E-11	-7.17619	2.229E-12

ID	NAME	ANAL MOL	CALC MOL	LOG ACTVTY	GAMMA	DIFF FXN
330	H+1	2.453E-08	3.752E-09	-8.48120	0.880182	4.500E-08
732	SO4-2	3.230E-03	2.972E-03	-2.74862	0.600192	-8.804E-09
800	Sr+2	1.485E-05	1.485E-05	-5.04998	0.600192	-4.369E-11
110	Be+2	1.111E-07	1.111E-07	-7.17614	0.600192	-3.268E-13
90	H3BO3	6.855E-05	5.721E-05	-4.24095	1.003695	-5.479E-12
1	E-1	0.000E-01	2.230E+08	8.34833	0.880182	-4.254E-12
180	Cl-1	4.574E-03	4.574E-03	-2.39517	0.880182	-3.364E-09
270	F-1	4.215E-05	9.239E-08	-7.08979	0.880182	5.120E-08
440	Li+1	1.010E-05	1.002E-05	-5.05460	0.880182	-7.427E-12
460	Mg+2	6.628E-04	5.445E-04	-3.48568	0.600192	1.372E-09
410	K+1	3.072E-04	3.034E-04	-3.57346	0.880182	-2.259E-10
492	NO3-1	4.289E-06	4.289E-06	-5.42306	0.880182	-3.155E-12
2	H2O	-1.301E-17	-8.046E-04	-0.00017	1.000000	0.000E-01
580	PO4-3	3.162E-07	1.714E-11	-11.26473	0.317069	-3.388E-21
150	Ca+2	1.483E-03	2.783E-04	-3.77717	0.600192	0.000E-01
140	CO3-2	2.012E-03	3.342E-05	-4.69776	0.600192	0.000E-01
280	Fe+2	1.792E-06	1.428E-06	-6.06703	0.600192	0.000E-01
281	Fe+3	8.961E-06	1.126E-27	-27.44736	0.317069	0.000E-01
500	Na+1	1.014E-02	1.004E-02	-2.05379	0.880182	3.251E-22
471	Mn+3	8.563E-06	5.623E-26	-25.74886	0.317069	0.000E-01
100	Ba+2	2.186E-07	9.870E-08	-7.22738	0.600192	0.000E-01

Type I - COMPONENTS AS SPECIES IN SOLUTION

ID	NAME	CALC MOL	ACTIVITY	LOG ACTVTY	GAMMA	NEW LOGK
330	H+1	3.752E-09	3.302E-09	-8.48120	0.88018	0.055
140	CO3-2	3.342E-05	2.006E-05	-4.69776	0.60019	0.222
100	Ba+2	9.870E-08	5.924E-08	-7.22738	0.60019	0.222
110	Be+2	1.111E-07	6.666E-08	-7.17614	0.60019	0.222
90	H3BO3	5.721E-05	5.742E-05	-4.24095	1.00370	-0.002
150	Ca+2	2.783E-04	1.670E-04	-3.77717	0.60019	0.222
180	Cl-1	4.574E-03	4.026E-03	-2.39517	0.88018	0.055
270	F-1	9.239E-08	8.132E-08	-7.08979	0.88018	0.055
440	Li+1	1.002E-05	8.819E-06	-5.05460	0.88018	0.055
460	Mg+2	5.445E-04	3.268E-04	-3.48568	0.60019	0.222
471	Mn+3	5.623E-26	1.783E-26	-25.74886	0.31707	0.499
492	NO3-1	4.289E-06	3.775E-06	-5.42306	0.88018	0.055
580	PO4-3	1.714E-11	5.436E-12	-11.26473	0.31707	0.499
410	K+1	3.034E-04	2.670E-04	-3.57346	0.88018	0.055
500	Na+1	1.004E-02	8.835E-03	-2.05379	0.88018	0.055
800	Sr+2	1.485E-05	8.913E-06	-5.04998	0.60019	0.222
732	SO4-2	2.972E-03	1.784E-03	-2.74862	0.60019	0.222
280	Fe+2	1.428E-06	8.570E-07	-6.06703	0.60019	0.222
281	Fe+3	1.126E-27	3.570E-28	-27.44736	0.31707	0.499

Type II - OTHER SPECIES IN SOLUTION OR ADSORBED

ID	NAME	CALC MOL	ACTIVITY	LOG ACTVTY	GAMMA	NEW LOGK
3305801	H2PO4 -	2.406E-09	2.118E-09	-8.67414	0.88018	19.608
3305802	H3PO4	9.774E-16	9.810E-16	-15.00834	1.00370	21.698
3300020	OH-	3.455E-06	3.041E-06	-5.51696	0.88018	-13.943
3300900	H2BO3 -1	1.135E-05	9.987E-06	-5.00055	0.88018	-9.185
902700	BF(OH)3 -	2.117E-12	1.863E-12	-11.72974	0.88018	-0.344

902701	BF2(OH)2 -	6.079E-20	5.351E-20	-19.27157	0.88018	7.685
902702	BF3OH -	1.778E-29	1.565E-29	-28.80539	0.88018	13.722
902703	BF4 -	1.933E-38	1.701E-38	-37.76922	0.88018	20.329
4603300	MgOH +	1.848E-07	1.626E-07	-6.78875	0.88018	-11.729
4602700	MgF +	1.995E-09	1.756E-09	-8.75547	0.88018	1.875
4601400	MgCO3 AQ	6.233E-06	6.256E-06	-5.20371	1.00370	2.978
4601401	MgHCO3 +	6.108E-06	5.376E-06	-5.26952	0.88018	11.451
4607320	MgSO4 AQ	1.033E-04	1.037E-04	-3.98430	1.00370	2.248
4605800	MgPO4 -	7.835E-09	6.896E-09	-8.16141	0.88018	6.644
4605801	MgH2PO4 +	2.562E-11	2.255E-11	-10.64681	0.88018	21.121
4605802	MgHPO4 AQ	9.700E-09	9.736E-09	-8.01161	1.00370	15.218
1503300	CaOH +	1.450E-08	1.276E-08	-7.89413	0.88018	-12.543
1501400	CaHCO3 +	2.782E-06	2.449E-06	-5.61104	0.88018	11.401
1501401	CaCO3 AQ	4.743E-06	4.761E-06	-5.32232	1.00370	3.151
1507320	CaSO4 AQ	6.048E-05	6.070E-05	-4.21679	1.00370	2.307
1505800	CaHPO4 AQ	3.633E-09	3.647E-09	-8.43810	1.00370	15.083
1505801	CaPO4 -	2.968E-09	2.613E-09	-8.58290	0.88018	6.514
1505802	CaH2PO4 +	1.026E-11	9.030E-12	-11.04431	0.88018	21.015
1502700	CaF +	1.344E-10	1.183E-10	-9.92696	0.88018	0.995
5001400	NaCO3 -	3.731E-06	3.284E-06	-5.48354	0.88018	1.323
5001401	NaHCO3 AQ	7.009E-06	7.035E-06	-5.15275	1.00370	10.078
5007320	NaSO4 -	8.975E-05	7.899E-05	-4.10242	0.88018	0.755
5005800	NaHPO4 -	7.793E-10	6.859E-10	-9.16373	0.88018	12.691
5002700	NaF AQ	1.161E-10	1.165E-10	-9.93358	1.00370	-0.792
4107320	KSO4 -	3.803E-06	3.348E-06	-5.47527	0.88018	0.902
4105800	KHPO4 -	2.377E-11	2.092E-11	-10.67939	0.88018	12.695
2803300	FeOH +	9.320E-08	8.204E-08	-7.08599	0.88018	-9.445
2803301	FeOH3 -1	2.701E-12	2.377E-12	-11.62392	0.88018	-30.945
2807320	FeSO4 AQ	2.709E-07	2.719E-07	-6.56565	1.00370	2.248
2805800	FeH2PO4 +	1.033E-12	9.096E-13	-12.04117	0.88018	22.308
2803302	FeOH2 AQ	2.106E-10	2.114E-10	-9.67496	1.00370	-20.572
2805801	FeHPO4 AQ	1.366E-10	1.371E-10	-9.86297	1.00370	15.948
2813300	FeOH +2	1.162E-21	6.977E-22	-21.15632	0.60019	-1.968
2815800	FeHPO4 +	4.387E-30	3.861E-30	-29.41330	0.88018	17.835
2817320	FeSO4 +	6.018E-27	5.297E-27	-26.27598	0.88018	3.975
2811800	FeCl +2	7.231E-29	4.340E-29	-28.36253	0.60019	1.702
2811801	FeCl2 +	8.866E-31	7.804E-31	-30.10769	0.88018	2.185
2811802	FeCl3 AQ	3.130E-34	3.142E-34	-33.50286	1.00370	1.128
2813301	FeOH2 +	7.946E-17	6.994E-17	-16.15529	0.88018	-5.615
2813302	FeOH3 AQ	2.478E-16	2.487E-16	-15.60425	1.00370	-13.602
2813303	FeOH4 -	8.555E-16	7.530E-16	-15.12321	0.88018	-21.545
2815801	FeH2PO4 +2	3.367E-31	2.021E-31	-30.69450	0.60019	25.202
2812700	FeF +2	7.648E-29	4.590E-29	-28.33815	0.60019	6.421
2812701	FeF2 +	1.692E-31	1.490E-31	-30.82694	0.88018	10.855
2812702	FeF3 AQ	1.913E-35	1.920E-35	-34.71673	1.00370	13.998
2817321	Fe(SO4)2 -	3.395E-28	2.988E-28	-27.52461	0.88018	5.475
2813304	Fe2(OH)2+4	1.010E-40	1.310E-41	-40.88265	0.12977	-2.063
2813305	Fe3(OH)4+5	4.653E-54	1.915E-55	-54.71794	0.04114	-4.914
4407320	LiSO4 -	7.802E-08	6.867E-08	-7.16322	0.88018	0.695
8003300	SrOH +	2.035E-10	1.791E-10	-9.74694	0.88018	-13.123
1003300	BaOH +	8.935E-13	7.864E-13	-12.10434	0.88018	-13.303
3301400	HCO3 -	1.607E-03	1.414E-03	-2.84940	0.88018	10.385
3301401	H2CO3 AQ	1.045E-05	1.049E-05	-4.97917	1.00370	16.679
3307320	HSO4 -	6.496E-10	5.718E-10	-9.24276	0.88018	2.042
3302700	HF AQ	3.948E-13	3.963E-13	-12.40199	1.00370	3.167
3302701	HF2 -	1.392E-19	1.225E-19	-18.91179	0.88018	3.804
3302702	H2F2 AQ	4.211E-25	4.227E-25	-24.37399	1.00370	6.766
3305800	HPO4 -2	6.634E-08	3.982E-08	-7.39994	0.60019	12.568

Type III - SPECIES WITH FIXED ACTIVITY

ID	NAME	CALC MOL	LOG MOL	NEW LOGK	DH
2	H2O	-8.046E-04	-3.094	0.000	0.000
7015003	HYDRAPATITE	-2.709E-05	-4.567	44.199	0.000
3301403	CO2 (g)	-8.016E-04	-3.096	21.660	-0.530
5015001	CALCITE	1.111E-03	-2.954	8.475	2.585
3028100	HEMATITE	4.481E-06	-5.349	4.008	30.845
2802810	Fe+2/Fe+3	-4.254E-12	-11.371	13.032	-10.000
7015002	FCO3APATITE	1.698E-05	-4.770	114.400	-39.390

Type IV - FINITE SOLIDS (present at equilibrium)

ID	NAME	CALC MOL	LOG MOL	NEW LOGK	DH
3047100	BIXBYITE	4.281E-06	-5.368	0.611	15.245
6010000	BARITE	1.199E-07	-6.921	9.976	-6.280

Type V - UNDERSATURATED SOLIDS (not present at equilibrium)

ID	NAME	CALC MOL	LOG MOL	NEW LOGK	DH
6080000	CELESTITE	4.639E-02	-1.334	6.465	0.470
3028102	LEPIDOCROCIT	4.216E-04	-3.375	-1.371	0.000
6046000	EPSOMITE	8.027E-05	-4.095	2.140	-2.820
2028100	FERRIHYDRITE	1.273E-07	-6.895	-4.891	0.000
2028101	FE3(OH)8	4.619E-14	-13.335	-20.222	0.000
4128100	FEOH)2.7CL.3	5.928E-03	-2.227	3.040	0.000
6028100	FE2(SO4)3	0.000E-01	-66.721	-3.580	59.120
2046000	BRUCITE	4.835E-04	-3.316	-16.792	25.840
5015000	ARAGONITE	7.263E-01	-0.139	8.336	2.615
4215000	FLUORITE	9.819E-08	-7.008	10.949	-4.710
2028102	GOETHITE	3.133E-03	-2.504	-0.500	14.480
6015001	GYPSUM	2.098E-02	-1.678	4.848	-0.261
4150000	HALITE	9.312E-07	-6.031	-1.582	-0.918
5046000	ARTINITE	4.926E-05	-4.308	-9.600	28.742
5015003	HUNTITE	8.765E-04	-3.057	29.968	25.760
5046001	HYDRMAGNESIT	3.221E-11	-10.492	8.766	52.210
6050000	JAROSITE NA	1.560E-28	-27.807	11.200	36.180
6041002	JAROSITE K	1.877E-26	-25.727	14.800	31.280
6028101	JAROSITE H	4.629E-34	-33.334	12.100	55.150
3028101	MAGHEMITE	4.036E-11	-10.394	-6.386	0.000
5046002	MAGNESITE	7.008E-01	-0.154	8.029	6.169
6015000	ANHYDRITE	1.292E-02	-1.889	4.637	3.769
6028000	MELANTERITE	4.500E-07	-6.347	2.470	-2.860
6050001	MIRABILITE	1.804E-06	-5.744	1.114	-18.987
3050000	NATRON	3.192E-08	-7.496	1.311	-15.745
5046003	NESQUEHONITE	2.736E-03	-2.563	5.621	5.789
5028000	SIDERITE	6.098E-01	-0.215	10.550	5.328
4280000	SRF2	2.044E-11	-10.690	8.540	-1.250
7028100	STRENGITE	4.871E-13	-12.312	26.400	2.030
5080000	STRONTIANITE	3.179E-01	-0.498	9.250	0.690
6050002	THENARDITE	2.103E-07	-6.677	0.179	0.572
5050001	THERMONATR	1.174E-09	-8.930	-0.125	2.802
7028001	VIVIANITE	1.854E-05	-4.732	36.000	0.000
5010000	WITHERITE	4.569E-04	-3.340	8.585	-0.360
2047000	PYROLUSITE	9.253E-17	-16.034	-15.861	29.180
2047001	BIRNESSITE	5.449E-19	-18.264	-18.091	0.000
2047002	NSUTITE	2.105E-18	-17.677	-17.504	0.000
4210000	BAF2	2.254E-16	-15.647	5.760	-1.000
2047100	MANGANITE	8.559E-01	-0.068	0.238	0.000
6047100	MN2(SO4)3	0.000E-01	-54.033	5.711	39.060
2015000	LIME	2.444E-20	-19.612	-32.797	46.265
2015001	PORTLANDITE	3.235E-10	-9.490	-22.675	30.690
2028000	WUSTITE	3.387E-01	-0.470	-11.687	24.846
2046001	PERICLASE	9.259E-09	-8.033	-21.510	36.135
3046001	MAG-FERRITE	5.053E-08	-7.296	-16.765	66.639

Type VI - EXCLUDED SPECIES (not included in mole balance)

ID	NAME	CALC MOL	LOG MOL	NEW LOGK	DH
5015002	DOLOMITE	2.196E+00	0.342	17.000	8.290
3028000	MAGNETITE	1.413E+03	3.150	-3.737	50.460
1	E-1	2.230E+08	8.348	0.000	0.000
3301404	CH4 (g)	2.384E+17	17.377	40.100	-61.000
3300021	O2 (g)	0.000E-01	-82.589	-83.120	133.830

PERCENTAGE DISTRIBUTION OF COMPONENTS AMONG
TYPE I and TYPE II (dissolved and adsorbed) species

H+1		98.7	PERCENT BOUND IN SPECIES #3301400	HCO3 -
	1.3	PERCENT BOUND IN SPECIES #3301401	H2CO3 AQ	
SO4-2		92.0	PERCENT BOUND IN SPECIES # 732	SO4-2
	3.2	PERCENT BOUND IN SPECIES #4607320	MgSO4 AQ	
	1.9	PERCENT BOUND IN SPECIES #1507320	CaSO4 AQ	
	2.8	PERCENT BOUND IN SPECIES #5007320	NaSO4 -	
Sr+2		100.0	PERCENT BOUND IN SPECIES # 800	Sr+2
Be+2		100.0	PERCENT BOUND IN SPECIES # 110	Be+2
H3BO3		83.4	PERCENT BOUND IN SPECIES # 90	H3BO3
	16.6	PERCENT BOUND IN SPECIES #3300900	H2BO3 -1	
E-1				
Cl-1		100.0	PERCENT BOUND IN SPECIES # 180	Cl-1
F-1		97.6	PERCENT BOUND IN SPECIES # 270	F-1
	2.1	PERCENT BOUND IN SPECIES #4602700	MgF +	
Li+1		99.2	PERCENT BOUND IN SPECIES # 440	Li+1
Mg+2		82.5	PERCENT BOUND IN SPECIES # 460	Mg+2
	15.6	PERCENT BOUND IN SPECIES #4607320	MgSO4 AQ	
K+1		98.8	PERCENT BOUND IN SPECIES # 410	K+1
	1.2	PERCENT BOUND IN SPECIES #4107320	KSO4 -	
NO3-1		100.0	PERCENT BOUND IN SPECIES # 492	NO3-1
H2O		92.2	PERCENT BOUND IN SPECIES #3300020	OH-
	4.9	PERCENT BOUND IN SPECIES #4603300	MgOH +	
	2.5	PERCENT BOUND IN SPECIES #2803300	FeOH +	
PO4-3		2.6	PERCENT BOUND IN SPECIES #3305801	H2PO4 -
	8.3	PERCENT BOUND IN SPECIES #4605800	MgPO4 -	
	10.3	PERCENT BOUND IN SPECIES #4605802	MgHPO4 AQ	
	3.9	PERCENT BOUND IN SPECIES #1505800	CaHPO4 AQ	
	3.2	PERCENT BOUND IN SPECIES #1505801	CaPO4 -	
	70.7	PERCENT BOUND IN SPECIES #3305800	HPO4 -2	
Ca+2		80.4	PERCENT BOUND IN SPECIES # 150	Ca+2
	1.4	PERCENT BOUND IN SPECIES #1501401	CaCO3 AQ	
	17.5	PERCENT BOUND IN SPECIES #1507320	CaSO4 AQ	
CO3-2		2.0	PERCENT BOUND IN SPECIES # 140	CO3-2
	95.6	PERCENT BOUND IN SPECIES #3301400	HCO3 -	
Fe+2		79.7	PERCENT BOUND IN SPECIES # 280	Fe+2
	5.2	PERCENT BOUND IN SPECIES #2803300	FeOH +	
	15.1	PERCENT BOUND IN SPECIES #2807320	FeSO4 AQ	
Fe+3		6.7	PERCENT BOUND IN SPECIES #2813301	FeOH2 +
	21.0	PERCENT BOUND IN SPECIES #2813302	FeOH3 AQ	
	72.3	PERCENT BOUND IN SPECIES #2813303	FeOH4 -	
Na+1		99.0	PERCENT BOUND IN SPECIES # 500	Na+1
Mn+3		100.0	PERCENT BOUND IN SPECIES # 471	Mn+3
Ba+2		100.0	PERCENT BOUND IN SPECIES # 100	Ba+2

---------- EQUILIBRATED MASS DISTRIBUTION ----------

IDX	NAME	DISSOLVED		SORBED		PRECIPITATED	
		MOL/KG	PERCENT	MOL/KG	PERCENT	MOL/KG	PERCENT
330	H+1	1.629E-03	100.0	0.000E-01	0.0	0.000E-01	0.0
732	SO4-2	3.230E-03	100.0	0.000E-01	0.0	1.199E-07	0.0
800	Sr+2	1.485E-05	100.0	0.000E-01	0.0	0.000E-01	0.0
110	Be+2	1.111E-07	100.0	0.000E-01	0.0	0.000E-01	0.0
90	H3BO3	6.855E-05	100.0	0.000E-01	0.0	0.000E-01	0.0
1	E-1	0.000E-01	0.0	0.000E-01	0.0	0.000E-01	0.0
180	Cl-1	4.574E-03	100.0	0.000E-01	0.0	0.000E-01	0.0
270	F-1	9.464E-08	100.0	0.000E-01	0.0	0.000E-01	0.0
440	Li+1	1.010E-05	100.0	0.000E-01	0.0	0.000E-01	0.0
460	Mg+2	6.604E-04	100.0	0.000E-01	0.0	0.000E-01	0.0
410	K+1	3.072E-04	100.0	0.000E-01	0.0	0.000E-01	0.0
492	NO3-1	4.289E-06	100.0	0.000E-01	0.0	0.000E-01	0.0
2	H2O	3.748E-06	100.0	0.000E-01	0.0	0.000E-01	0.0
580	PO4-3	9.388E-08	100.0	0.000E-01	0.0	0.000E-01	0.0
150	Ca+2	3.463E-04	100.0	0.000E-01	0.0	0.000E-01	0.0
140	CO3-2	1.682E-03	100.0	0.000E-01	0.0	0.000E-01	0.0
280	Fe+2	1.792E-06	100.0	0.000E-01	0.0	0.000E-01	0.0
281	Fe+3	1.183E-15	100.0	0.000E-01	0.0	0.000E-01	0.0
500	Na+1	1.014E-02	100.0	0.000E-01	0.0	0.000E-01	0.0
471	Mn+3	5.623E-26	0.0	0.000E-01	0.0	8.563E-06	100.0
100	Ba+2	9.870E-08	45.1	0.000E-01	0.0	1.199E-07	54.9

Charge Balance: SPECIATED

Sum of CATIONS = 1.204E-02 Sum of ANIONS 1.231E-02

PERCENT DIFFERENCE = 1.108E+00 (ANIONS - CATIONS)/(ANIONS + CATIONS)

EQUILIBRIUM IONIC STRENGTH (m) = 1.602E-02

EQUILIBRIUM pH = 8.481

EQUILIBRIUM pe = -8.348 or Eh = -493.85 mv

DATE ID NUMBER: 960925
TIME ID NUMBER: 11195102

Saturation indices and stoichiometry of all minerals

ID #	NAME	Sat. Index	Stoichiometry in [brackets]
6015000	ANHYDRITE	-1.889	[1.000] 150 [1.000] 732
5015000	ARAGONITE	-0.139	[1.000] 150 [1.000] 140
5046000	ARTINITE	-4.308	[-2.000] 330 [2.000] 460 [1.000] 140 [5.000] 2
4210000	BAF2	-15.647	[1.000] 100 [2.000] 270
6010000	BARITE	0.000	[1.000] 100 [1.000] 732
2046000	BRUCITE	-3.316	[1.000] 460 [2.000] 2 [-2.000] 330
5015001	CALCITE	0.000	[1.000] 150 [1.000] 140
6080000	CELESTITE	-1.334	[1.000] 800 [1.000] 732
5015002	DOLOMITE	0.342	[1.000] 150 [1.000] 460 [2.000] 140
6046000	EPSOMITE	-4.095	[1.000] 460 [1.000] 732 [7.000] 2
2028100	FERRIHYDRITE	-6.895	[-3.000] 330 [1.000] 281 [3.000] 2
2028101	FE3(OH)8	-13.335	[-8.000] 330 [2.000] 281 [1.000] 280 [8.000] 2
4128100	FEOH)2.7CL.3	-2.227	[-2.700] 330 [1.000] 281 [2.700] 2 [0.300] 180
6028100	FE2(SO4)3	-66.721	[2.000] 281 [3.000] 732
7015003	HYDRAPATITE	0.000	[5.000] 150 [3.000] 580 [1.000] 2 [-1.000] 330
7015002	FCO3APATITE	0.000	[9.496] 150 [0.360] 500 [0.144] 460 [4.800] 580 [1.200] 140 [2.480] 270
4215000	FLUORITE	-7.008	[1.000] 150 [2.000] 270
2028102	GOETHITE	-2.504	[-3.000] 330 [1.000] 281 [2.000] 2
6015001	GYPSUM	-1.678	[1.000] 150 [1.000] 732 [2.000] 2
4150000	HALITE	-6.031	[1.000] 500 [1.000] 180
3028100	HEMATITE	0.000	[-6.000] 330 [2.000] 281 [3.000] 2
5015003	HUNTITE	-3.057	[3.000] 460 [1.000] 150 [4.000] 140
5046001	HYDRMAGNESIT	-10.492	[5.000] 460 [4.000] 140 [-2.000] 330 [6.000] 2
6050000	JAROSITE NA	-27.807	[-6.000] 330 [1.000] 500 [3.000] 281 [2.000] 732 [6.000] 2
6041002	JAROSITE K	-25.727	[-6.000] 330 [1.000] 410 [3.000] 281 [2.000] 732 [6.000] 2
6028101	JAROSITE H	-33.334	[-5.000] 330 [3.000] 281 [2.000] 732 [7.000] 2
3028101	MAGHEMITE	-10.394	[-6.000] 330 [2.000] 281 [3.000] 2
5046002	MAGNESITE	-0.154	[1.000] 460 [1.000] 140
3028000	MAGNETITE	3.150	[-8.000] 330 [2.000] 281 [1.000] 280 [4.000] 2
6028000	MELANTERITE	-6.347	[1.000] 280 [1.000] 732 [7.000] 2
6050001	MIRABILITE	-5.744	[2.000] 500 [1.000] 732 [10.000] 2
3050000	NATRON	-7.496	[2.000] 500 [1.000] 140 [10.000] 2
5046003	NESQUEHONITE	-2.563	[1.000] 460 [1.000] 140 [3.000] 2

ID #	NAME	Sat. Index	Stoichiometry in [brackets]
5028000	SIDERITE	-0.215	[1.000] 280 [1.000] 140
4280000	SRF2	-10.690	[1.000] 800 [2.000] 270
7028100	STRENGITE	-12.312	[1.000] 281 [1.000] 580 [2.000] 2
5080000	STRONTIANITE	-0.498	[1.000] 800 [1.000] 140
6050002	THENARDITE	-6.677	[2.000] 500 [1.000] 732
5050001	THERMONATR	-8.930	[2.000] 500 [1.000] 140 [1.000] 2
7028001	VIVIANITE	-4.732	[3.000] 280 [2.000] 580 [8.000] 2
5010000	WITHERITE	-3.340	[1.000] 100 [1.000] 140
2047000	PYROLUSITE	-16.034	[-4.000] 330 [-1.000] 1 [1.000] 471
			[2.000] 2
2047001	BIRNESSITE	-18.264	[-4.000] 330 [-1.000] 1 [1.000] 471
			[2.000] 2
2047002	NSUTITE	-17.677	[-4.000] 330 [-1.000] 1 [1.000] 471
			[2.000] 2
3047100	BIXBYITE	0.000	[-6.000] 330 [2.000] 471 [3.000] 2
2047100	MANGANITE	-0.068	[-3.000] 330 [1.000] 471 [2.000] 2
6047100	MN2(SO4)3	-54.033	[2.000] 471 [3.000] 732
2015000	LIME	-19.612	[-2.000] 330 [1.000] 150 [1.000] 2
2015001	PORTLANDITE	-9.490	[-2.000] 330 [1.000] 150 [2.000] 2
2028000	WUSTITE	-0.470	[-2.000] 330 [0.947] 280 [1.000] 2
2046001	PERICLASE	-8.033	[-2.000] 330 [1.000] 460 [1.000] 2
3046001	MAG-FERRITE	-7.296	[-8.000] 330 [1.000] 460 [2.000] 281
			[4.000] 2
3028102	LEPIDOCROCIT	-3.375	[-3.000] 330 [1.000] 281 [2.000] 2

```
EQUILIBRATION OF 1312 LEACHATE - SAMPLE E-2 SERICITE GNEISS
pCO2=10E-3.5; INFINITE CALCITE, HEMATITE, APATITE; CALCULATE Eh

25.00 MG/L   0.000  0.00000E-01
1 0 1 2 3 0 0 0 1 2 0 0 0
0   0   0
    330  1.561E-05   -7.81 y                  /H+1
    180  1.800E+00   -4.29 y                  /Cl-1
    270  2.000E-01   -4.98 y                  /F-1
    580  2.000E-02   -6.68 y                  /PO4-3
     30  3.400E-01   -4.90 y                  /Al+3
    100  3.800E-01   -5.56 y                  /Ba+2
    110  1.000E-03   -6.95 y                  /Be+2
    150  1.380E+01   -3.46 y                  /Ca+2
    460  6.000E-01   -3.00 y                  /Mg+2
    471  1.300E-01   -5.63                    /Mn+3
    762  5.000E-02   -6.46 y                  /SeO4-2
    500  8.000E+00   -3.46 y                  /Na+1
    800  2.100E-01   -5.62 y                  /Sr+2
    950  3.500E-01   -5.27 y                  /Zn+2
     90  1.430E+00   -4.64 y                  /H3BO3
    140  2.278E+01   -6.84 y                  /Total CO3-2 alkali
      1  0.000E-01    7.69 y                  /E- (ENTERED AS EH)
    280  1.000E-02   -5.75 y                  /Fe+2
    281  9.000E-02   -5.75                    /Fe+3

  3   6
3301403    21.6600    -0.5300                /CO2 (g)
5015001     8.4750     2.5850                /CALCITE
3028100     4.0080    30.8450                /HEMATITE
7015003    44.1990     0.0000                /HYDRAPATITE
7015002   114.4000   -39.3900                /FCO3APATITE
2802810    13.0320   -10.0000                /Fe+2/Fe+3
  6   4
5015000     8.3600     2.6150                /ARAGONITE
5015002    17.0000     8.2900                /DOLOMITE
      1     0.0000     0.0000                /E-1
3028000    -3.7370    50.4600                /MAGNETITE
```

APPENDIX C

MODEL OUTPUT FOR EQUILIBRATION OF 1312 LEACHATE - SAMPLE E-2 SERICITE GNEISS

EQUILIBRATION OF 1312 LEACHATE - SAMPLE E-2 SERICITE GNEISS
pCO2=10E-3.5; INFINITE CALCITE, HEMATITE, APATITE; CALCULATE Eh

---

Temperature (Celsius): 25.00
Units of concentration: MG/L
Ionic strength to be computed.
Carbonate concentration represents carbonate alkalinity.
Do not automatically terminate if charge imbalance exceeds 30%
Precipitation is allowed for all solids in the thermodynamic database and
the print option for solids is set to: 2
The maximum number of iterations is: 200
The method used to compute activity coefficients is: Davies equation
Abbreviated output file

330	1.561E-05	-7.81 y
180	1.800E+00	-4.29 y
270	2.000E-01	-4.98 y
580	2.000E-02	-6.68 y
30	3.400E-01	-4.90 y
100	3.800E-01	-5.56 y
110	1.000E-03	-6.95 y
150	1.380E+01	-3.46 y
460	6.000E-01	-3.00 y
471	1.300E-01	-5.63
762	5.000E-02	-6.46 y
500	8.000E+00	-3.46 y
800	2.100E-01	-5.62 y
950	3.500E-01	-5.27 y
90	1.430E+00	-4.64 y
140	2.278E+01	-6.84 y
1	0.000E-01	7.69 y
280	1.000E-02	-5.75 y
281	9.000E-02	-5.75

H2O has been inserted as a COMPONENT

3	6	
3301403	21.6600	-0.5300
5015001	8.4750	2.5850
3028100	4.0080	30.8450
7015003	44.1990	0.0000
7015002	114.4000	-39.3900
2802810	13.0320	-10.0000
6	4	
5015000	8.3600	2.6150
5015002	17.0000	8.2900
1	0.0000	0.0000
3028000	-3.7370	50.4600

Charge Balance: UNSPECIATED

Sum of CATIONS= 1.157E-03 Sum of ANIONS = 8.219E-04

PERCENT DIFFERENCE = 1.695E+01 (ANIONS - CATIONS)/(ANIONS + CATIONS)

IMPROVED ACTIVITY GUESSES PRIOR TO FIRST ITERATION:

PO4-3	Log activity guess:	-11.31
Al+3	Log activity guess:	-13.20
SeO4-2	Log activity guess:	-6.46
CO3-2	Log activity guess:	-6.04
Fe+2	Log activity guess:	-5.76
Fe+3	Log activity guess:	-18.79

PARAMETERS OF THE COMPONENT MOST OUT OF BALANCE:

ITER	NAME	TOTAL MOL	DIFF FXN	LOG ACTVTY	RESIDUAL
0	Sr+2	2.397E-06	2.010E-09	-5.62000	1.770E-09
1	H3BO3	2.313E-05	7.334E-07	-4.66101	7.311E-07
2	Sr+2	2.397E-06	1.210E-06	-5.62037	1.210E-06
3	Sr+2	2.397E-06	-1.481E-06	-5.79786	1.481E-06
4	Sr+2	2.397E-06	1.055E-05	-5.37996	1.055E-05
5	Sr+2	2.397E-06	3.132E-07	-6.11242	3.129E-07
6	Sr+2	2.397E-06	2.996E-07	-6.16575	2.993E-07
7	Sr+2	2.397E-06	-2.298E-07	-6.21689	2.296E-07
8	Sr+2	2.397E-06	-4.129E-07	-6.17312	4.127E-07
9	Sr+2	2.397E-06	-6.029E-07	-6.09101	6.026E-07
10	Sr+2	2.397E-06	-5.285E-07	-5.96518	5.283E-07
11	Sr+2	2.397E-06	-3.735E-07	-5.85700	3.732E-07
12	Sr+2	2.397E-06	-2.278E-07	-5.78344	2.276E-07
13	Sr+2	2.397E-06	-1.209E-07	-5.74006	1.206E-07
14	Mg+2	-1.145E-04	-1.972E-04	-4.72250	1.971E-04
15	Mg+2	-1.145E-04	-5.252E-05	-4.72249	5.250E-05
16	Mg+2	-1.145E-04	-7.376E-06	-4.72249	7.362E-06
17	Mg+2	-1.145E-04	-2.089E-07	-4.72248	1.950E-07
19	Sr+2	2.397E-06	-8.404E-08	-5.71759	8.380E-08
20	Sr+2	2.397E-06	-3.342E-09	-5.70208	3.102E-09
21	Mn+3	2.366E-06	-3.319E-10	-5.80841	9.528E-11

ID	NAME	ANAL MOL	CALC MOL	LOG ACTVTY	GAMMA	DIFF FXN
330	H+1	1.549E-08	5.351E-09	-8.29187	0.954397	-4.002E-10
180	Cl-1	5.077E-05	5.077E-05	-4.31463	0.954397	-3.104E-11
270	F-1	7.748E-04	1.100E-07	-6.97897	0.954397	1.452E-09
950	Zn+2	5.354E-06	1.589E-06	-5.88009	0.829691	-5.295E-12
30	Al+3	1.260E-05	1.187E-15	-15.10804	0.656995	-7.369E-12
100	Ba+2	2.767E-06	2.767E-06	-5.63908	0.829691	-6.767E-12
110	Be+2	1.110E-07	1.110E-07	-7.03589	0.829691	-2.714E-13
280	Fe+2	1.791E-07	1.699E-07	-6.85089	0.829691	-4.211E-13
460	Mg+2	6.906E-05	2.369E-05	-4.70648	0.829691	2.623E-11
471	Mn+3	2.366E-06	2.366E-06	-5.80835	0.656995	-1.302E-11
762	SeO4-2	3.498E-07	3.497E-07	-6.53738	0.829691	-8.552E-13
90	H3BO3	2.313E-05	2.069E-05	-4.68409	1.000402	-1.261E-12
800	Sr+2	2.397E-06	2.397E-06	-5.70145	0.829691	-5.861E-12
580	PO4-3	1.479E-03	2.238E-12	-11.83251	0.656995	2.711E-20
1	E-1	0.000E-01	9.925E+06	6.99671	0.954397	0.000E-01
150	Ca+2	3.271E-03	4.813E-04	-3.39866	0.829691	0.000E-01
500	Na+1	4.589E-04	3.463E-04	-3.48087	0.954397	-3.047E-21
281	Fe+3	1.612E-06	2.008E-27	-26.87961	0.656995	0.000E-01
2	H2O	0.000E-01	-5.143E-04	-0.00001	1.000000	0.000E-01
140	CO3-2	7.494E-04	1.011E-05	-5.07626	0.829691	1.297E-21

PERCENTAGE DISTRIBUTION OF COMPONENTS AMONG
TYPE I and TYPE II (dissolved and adsorbed) species

H+1		103.3	PERCENT BOUND IN SPECIES	#3301400	HCO3 -
	2.3	PERCENT BOUND IN SPECIES	#3301401	H2CO3 AQ	
Cl-1		100.0	PERCENT BOUND IN SPECIES	# 180	Cl-1
F-1		99.5	PERCENT BOUND IN SPECIES	# 270	F-1
Zn+2		29.7	PERCENT BOUND IN SPECIES	# 950	Zn+2
	5.5	PERCENT BOUND IN SPECIES	#9503300	ZnOH +	
	11.9	PERCENT BOUND IN SPECIES	#9503301	Zn(OH)2 AQ	
	2.8	PERCENT BOUND IN SPECIES	#9501400	ZnHCO3 +	
	41.2	PERCENT BOUND IN SPECIES	#9501401	ZnCO3 AQ	
	8.9	PERCENT BOUND IN SPECIES	#9501402	Zn(CO3)2-2	
Al+3		95.3	PERCENT BOUND IN SPECIES	# 303302	Al(OH)4 -
	4.6	PERCENT BOUND IN SPECIES	# 303303	Al(OH)3 AQ	
Ba+2		100.0	PERCENT BOUND IN SPECIES	# 100	Ba+2
Be+2		100.0	PERCENT BOUND IN SPECIES	# 110	Be+2
Fe+2		94.9	PERCENT BOUND IN SPECIES	# 280	Fe+2
	5.1	PERCENT BOUND IN SPECIES	#2803300	FeOH +	
Mg+2		98.4	PERCENT BOUND IN SPECIES	# 460	Mg+2
Mn+3		100.0	PERCENT BOUND IN SPECIES	# 471	Mn+3
SeO4-2		100.0	PERCENT BOUND IN SPECIES	# 762	SeO4-2
H3BO3		89.5	PERCENT BOUND IN SPECIES	# 90	H3BO3
	10.5	PERCENT BOUND IN SPECIES	#3300900	H2BO3 -1	
Sr+2		100.0	PERCENT BOUND IN SPECIES	# 800	Sr+2
PO4-3		13.3	PERCENT BOUND IN SPECIES	#1505800	CaHPO4 AQ
	6.5	PERCENT BOUND IN SPECIES	#1505801	CaPO4 -	
	73.5	PERCENT BOUND IN SPECIES	#3305800	HPO4 -2	
	5.3	PERCENT BOUND IN SPECIES	#3305801	H2PO4 -	
E-1					
Ca+2		98.2	PERCENT BOUND IN SPECIES	# 150	Ca+2
Na+1		99.9	PERCENT BOUND IN SPECIES	# 500	Na+1
Fe+3		13.0	PERCENT BOUND IN SPECIES	#2813301	FeOH2 +
	28.5	PERCENT BOUND IN SPECIES	#2813302	FeOH3 AQ	
	58.5	PERCENT BOUND IN SPECIES	#2813303	FeOH4 -	
H2O		3.9	PERCENT BOUND IN SPECIES	#3300020	OH-
	89.8	PERCENT BOUND IN SPECIES	# 303302	Al(OH)4 -	
	3.3	PERCENT BOUND IN SPECIES	# 303303	Al(OH)3 AQ	
	2.4	PERCENT BOUND IN SPECIES	#9503301	Zn(OH)2 AQ	
CO3-2		1.0	PERCENT BOUND IN SPECIES	# 140	CO3-2
	96.6	PERCENT BOUND IN SPECIES	#3301400	HCO3 -	
	1.1	PERCENT BOUND IN SPECIES	#3301401	H2CO3 AQ	

---------- PROVISIONAL MASS DISTRIBUTION ----------

IDX	NAME	DISSOLVED MOL/KG	DISSOLVED PERCENT	SORBED MOL/KG	SORBED PERCENT	PRECIPITATED MOL/KG	PRECIPITATED PERCENT
330	H+1	9.283E-04	100.0	0.000E-01	0.0	0.000E-01	0.0
180	Cl-1	5.077E-05	100.0	0.000E-01	0.0	0.000E-01	0.0
270	F-1	1.105E-07	100.0	0.000E-01	0.0	0.000E-01	0.0
950	Zn+2	5.354E-06	100.0	0.000E-01	0.0	0.000E-01	0.0
30	Al+3	1.260E-05	100.0	0.000E-01	0.0	0.000E-01	0.0
100	Ba+2	2.767E-06	100.0	0.000E-01	0.0	0.000E-01	0.0
110	Be+2	1.110E-07	100.0	0.000E-01	0.0	0.000E-01	0.0
280	Fe+2	1.791E-07	100.0	0.000E-01	0.0	0.000E-01	0.0
460	Mg+2	2.408E-05	100.0	0.000E-01	0.0	0.000E-01	0.0
471	Mn+3	2.366E-06	100.0	0.000E-01	0.0	0.000E-01	0.0
762	SeO4-2	3.498E-07	100.0	0.000E-01	0.0	0.000E-01	0.0
90	H3BO3	2.313E-05	100.0	0.000E-01	0.0	0.000E-01	0.0
800	Sr+2	2.397E-06	100.0	0.000E-01	0.0	0.000E-01	0.0
580	PO4-3	2.733E-08	100.0	0.000E-01	0.0	0.000E-01	0.0
1	E-1	0.000E-01	0.0	0.000E-01	0.0	0.000E-01	0.0
150	Ca+2	4.901E-04	100.0	0.000E-01	0.0	0.000E-01	0.0
500	Na+1	3.465E-04	100.0	0.000E-01	0.0	0.000E-01	0.0
281	Fe+3	8.728E-16	100.0	0.000E-01	0.0	0.000E-01	0.0
2	H2O	5.349E-05	100.0	0.000E-01	0.0	0.000E-01	0.0
140	CO3-2	9.920E-04	100.0	0.000E-01	0.0	0.000E-01	0.0

Charge Balance: SPECIATED

Sum of CATIONS = 1.382E-03 Sum of ANIONS 1.048E-03

PERCENT DIFFERENCE = 1.374E+01 (ANIONS - CATIONS)/(ANIONS + CATIONS)

PROVISIONAL IONIC STRENGTH (m) = 1.745E-03

PC MINTEQA2 v3.10 DATE OF CALCULATIONS: 24-SEP-96 TIME: 9:18: 4

ITERATIONS= 22: SOLID BIXBYITE PRECIPITATES

PARAMETERS OF THE COMPONENT MOST OUT OF BALANCE:

ITER	NAME	TOTAL MOL	DIFF FXN	LOG ACTVTY	RESIDUAL
22	H3BO3	2.313E-05	-1.029E-07	-4.68409	1.006E-07
23	H3BO3	2.313E-05	9.934E-08	-4.68004	9.702E-08
24	H3BO3	2.313E-05	6.979E-09	-4.68377	4.666E-09
25	Mg+2	-1.145E-04	-6.738E-08	-4.70627	5.352E-08

ID	NAME	ANAL MOL	CALC MOL	LOG ACTVTY	GAMMA	DIFF FXN
330	H+1	1.549E-08	5.363E-09	-8.29079	0.954488	-6.962E-10
180	Cl-1	5.077E-05	5.077E-05	-4.31459	0.954488	-2.924E-11
270	F-1	7.748E-04	1.097E-07	-6.97995	0.954488	1.020E-09
950	Zn+2	5.354E-06	1.594E-06	-5.87840	0.830009	-4.993E-12
30	Al+3	1.260E-05	1.198E-15	-15.10370	0.657561	-6.982E-12
100	Ba+2	2.767E-06	2.767E-06	-5.63891	0.830009	-6.374E-12
110	Be+2	1.110E-07	1.110E-07	-7.03573	0.830009	-2.556E-13
280	Fe+2	1.791E-07	1.699E-07	-6.85068	0.830009	-3.967E-13
460	Mg+2	6.906E-05	2.369E-05	-4.70630	0.830009	4.518E-12
800	Sr+2	2.397E-06	2.397E-06	-5.70129	0.830009	-5.522E-12
762	SeO4-2	3.498E-07	3.497E-07	-6.53722	0.830009	-8.056E-13
90	H3BO3	2.313E-05	2.069E-05	-4.68397	1.000400	-1.185E-12
471	Mn+3	2.366E-06	1.010E-25	-25.17784	0.657561	-1.898E-20
1	E-1	0.000E-01	9.855E+06	6.99367	0.954488	0.000E-01
580	PO4-3	1.479E-03	2.220E-12	-11.83577	0.657561	-1.146E-20
500	Na+1	4.589E-04	3.463E-04	-3.48083	0.954488	2.349E-21
281	Fe+3	1.612E-06	2.022E-27	-26.87634	0.657561	0.000E-01
150	Ca+2	3.271E-03	4.835E-04	-3.39649	0.830009	8.470E-22
140	CO3-2	7.494E-04	1.006E-05	-5.07844	0.830009	2.975E-20
2	H2O	0.000E-01	-5.131E-04	-0.00001	1.000000	0.000E-01

PERCENTAGE DISTRIBUTION OF COMPONENTS AMONG
TYPE I and TYPE II (dissolved and adsorbed) species

H+1	103.3	PERCENT BOUND IN SPECIES	#3301400	HCO3 -
2.3	PERCENT BOUND IN SPECIES	#3301401	H2CO3 AQ	
Cl-1	100.0	PERCENT BOUND IN SPECIES	# 180	Cl-1
F-1	99.5	PERCENT BOUND IN SPECIES	# 270	F-1
Zn+2	29.8	PERCENT BOUND IN SPECIES	# 950	Zn+2
5.5	PERCENT BOUND IN SPECIES	#9503300	ZnOH +	
11.9	PERCENT BOUND IN SPECIES	#9503301	Zn(OH)2 AQ	
2.8	PERCENT BOUND IN SPECIES	#9501400	ZnHCO3 +	
41.1	PERCENT BOUND IN SPECIES	#9501401	ZnCO3 AQ	
8.8	PERCENT BOUND IN SPECIES	#9501402	Zn(CO3)2-2	
Al+3	95.3	PERCENT BOUND IN SPECIES	# 303302	Al(OH)4 -
4.7	PERCENT BOUND IN SPECIES	# 303303	Al(OH)3 AQ	
Ba+2	100.0	PERCENT BOUND IN SPECIES	# 100	Ba+2
Be+2	100.0	PERCENT BOUND IN SPECIES	# 110	Be+2
Fe+2	94.9	PERCENT BOUND IN SPECIES	# 280	Fe+2
5.1	PERCENT BOUND IN SPECIES	#2803300	FeOH +	
Mg+2	98.4	PERCENT BOUND IN SPECIES	# 460	Mg+2
Sr+2	100.0	PERCENT BOUND IN SPECIES	# 800	Sr+2
SeO4-2	100.0	PERCENT BOUND IN SPECIES	# 762	SeO4-2
H3BO3	89.5	PERCENT BOUND IN SPECIES	# 90	H3BO3
10.5	PERCENT BOUND IN SPECIES	#3300900	H2BO3 -1	
Mn+3	100.0	PERCENT BOUND IN SPECIES	# 471	Mn+3
E-1				
PO4-3	13.4	PERCENT BOUND IN SPECIES	#1505800	CaHPO4 AQ
6.5	PERCENT BOUND IN SPECIES	#1505801	CaPO4 -	
73.4	PERCENT BOUND IN SPECIES	#3305800	HPO4 -2	
5.3	PERCENT BOUND IN SPECIES	#3305801	H2PO4 -	
Na+1	99.9	PERCENT BOUND IN SPECIES	# 500	Na+1
Fe+3	13.0	PERCENT BOUND IN SPECIES	#2813301	FeOH2 +
28.5	PERCENT BOUND IN SPECIES	#2813302	FeOH3 AQ	
58.4	PERCENT BOUND IN SPECIES	#2813303	FeOH4 -	
Ca+2	98.2	PERCENT BOUND IN SPECIES	# 150	Ca+2
CO3-2	1.0	PERCENT BOUND IN SPECIES	# 140	CO3-2
96.6	PERCENT BOUND IN SPECIES	#3301400	HCO3 -	
1.1	PERCENT BOUND IN SPECIES	#3301401	H2CO3 AQ	
H2O	3.8	PERCENT BOUND IN SPECIES	#3300020	OH-
89.8	PERCENT BOUND IN SPECIES	# 303302	Al(OH)4 -	
3.3	PERCENT BOUND IN SPECIES	# 303303	Al(OH)3 AQ	
2.4	PERCENT BOUND IN SPECIES	#9503301	Zn(OH)2 AQ	

PART 5 of OUTPUT FILE

PC MINTEQA2 v3.10 DATE OF CALCULATIONS: 24-SEP-96 TIME: 9:18: 5

---------- PROVISIONAL MASS DISTRIBUTION ----------

IDX	NAME	DISSOLVED		SORBED		PRECIPITATED	
		MOL/KG	PERCENT	MOL/KG	PERCENT	MOL/KG	PERCENT
330	H+1	9.259E-04	100.0	0.000E-01	0.0	0.000E-01	0.0
180	Cl-1	5.077E-05	100.0	0.000E-01	0.0	0.000E-01	0.0
270	F-1	1.103E-07	100.0	0.000E-01	0.0	0.000E-01	0.0
950	Zn+2	5.354E-06	100.0	0.000E-01	0.0	0.000E-01	0.0
30	Al+3	1.260E-05	100.0	0.000E-01	0.0	0.000E-01	0.0
100	Ba+2	2.767E-06	100.0	0.000E-01	0.0	0.000E-01	0.0
110	Be+2	1.110E-07	100.0	0.000E-01	0.0	0.000E-01	0.0
280	Fe+2	1.791E-07	100.0	0.000E-01	0.0	0.000E-01	0.0
460	Mg+2	2.408E-05	100.0	0.000E-01	0.0	0.000E-01	0.0
800	Sr+2	2.397E-06	100.0	0.000E-01	0.0	0.000E-01	0.0
762	SeO4-2	3.498E-07	100.0	0.000E-01	0.0	0.000E-01	0.0
90	H3BO3	2.313E-05	100.0	0.000E-01	0.0	0.000E-01	0.0
471	Mn+3	1.010E-25	0.0	0.000E-01	0.0	2.366E-06	100.0
1	E-1	0.000E-01	0.0	0.000E-01	0.0	0.000E-01	0.0
580	PO4-3	2.721E-08	100.0	0.000E-01	0.0	0.000E-01	0.0
500	Na+1	3.465E-04	100.0	0.000E-01	0.0	0.000E-01	0.0
281	Fe+3	8.717E-16	100.0	0.000E-01	0.0	0.000E-01	0.0
150	Ca+2	4.923E-04	100.0	0.000E-01	0.0	0.000E-01	0.0
140	CO3-2	9.894E-04	100.0	0.000E-01	0.0	0.000E-01	0.0
2	H2O	5.348E-05	100.0	0.000E-01	0.0	0.000E-01	0.0

Charge Balance: SPECIATED

Sum of CATIONS = 1.379E-03 Sum of ANIONS 1.045E-03

PERCENT DIFFERENCE = 1.377E+01 (ANIONS - CATIONS)/(ANIONS + CATIONS)

PROVISIONAL IONIC STRENGTH (m) = 1.738E-03

PC MINTEQA2 v3.10 DATE OF CALCULATIONS: 24-SEP-96 TIME: 9:18: 5

ITERATIONS= 26: SOLID DIASPORE PRECIPITATES

PARAMETERS OF THE COMPONENT MOST OUT OF BALANCE:

ITER	NAME	TOTAL MOL	DIFF FXN	LOG ACTVTY	RESIDUAL
26	SeO4-2	3.498E-07	-5.945E-08	-6.53722	5.941E-08
27	SeO4-2	3.498E-07	6.847E-08	-6.45632	6.843E-08
28	SeO4-2	3.498E-07	2.393E-09	-6.53396	2.358E-09
29	Mg+2	-1.145E-04	-6.341E-08	-4.70604	4.955E-08

ID	NAME	ANAL MOL	CALC MOL	LOG ACTVTY	GAMMA	DIFF FXN
330	H+1	1.549E-08	5.342E-09	-8.29249	0.954637	-5.930E-10
180	Cl-1	5.077E-05	5.077E-05	-4.31453	0.954637	-2.336E-11
270	F-1	7.748E-04	1.101E-07	-6.97846	0.954637	7.789E-10
950	Zn+2	5.354E-06	1.584E-06	-5.88085	0.830526	-3.979E-12
90	H3BO3	2.313E-05	2.069E-05	-4.68415	1.000397	-9.514E-13
100	Ba+2	2.767E-06	2.767E-06	-5.63864	0.830526	-5.092E-12
110	Be+2	1.110E-07	1.110E-07	-7.03546	0.830526	-2.042E-13
280	Fe+2	1.791E-07	1.699E-07	-6.85050	0.830526	-3.168E-13
460	Mg+2	6.906E-05	2.369E-05	-4.70607	0.830526	1.533E-12
800	Sr+2	2.397E-06	2.397E-06	-5.70101	0.830526	-4.410E-12
762	SeO4-2	3.498E-07	3.497E-07	-6.53695	0.830526	-6.435E-13
30	Al+3	1.260E-05	1.503E-18	-18.00446	0.658484	0.000E-01
1	E-1	0.000E-01	9.976E+06	6.99896	0.954637	0.000E-01
140	CO3-2	7.494E-04	1.013E-05	-5.07502	0.830526	0.000E-01
580	PO4-3	1.479E-03	2.243E-12	-11.83066	0.658484	-3.785E-21
281	Fe+3	1.612E-06	1.995E-27	-26.88146	0.658484	0.000E-01
500	Na+1	4.589E-04	3.463E-04	-3.48076	0.954637	-7.548E-24
150	Ca+2	3.271E-03	4.795E-04	-3.39990	0.830526	7.263E-20
471	Mn+3	2.366E-06	9.965E-26	-25.18296	0.658484	0.000E-01
2	H2O	0.000E-01	-4.963E-04	-0.00001	1.000000	0.000E-01

PERCENTAGE DISTRIBUTION OF COMPONENTS AMONG
TYPE I and TYPE II (dissolved and adsorbed) species

H+1	98.0	PERCENT BOUND IN SPECIES	#3301400	HCO3 -
	2.1	PERCENT BOUND IN SPECIES	#3301401	H2CO3 AQ
Cl-1	100.0	PERCENT BOUND IN SPECIES	# 180	Cl-1
F-1	99.5	PERCENT BOUND IN SPECIES	# 270	F-1
Zn+2	29.6	PERCENT BOUND IN SPECIES	# 950	Zn+2
	5.5	PERCENT BOUND IN SPECIES	#9503300	ZnOH +
	11.9	PERCENT BOUND IN SPECIES	#9503301	Zn(OH)2 AQ
	2.8	PERCENT BOUND IN SPECIES	#9501400	ZnHCO3 +
	41.2	PERCENT BOUND IN SPECIES	#9501401	ZnCO3 AQ
	8.9	PERCENT BOUND IN SPECIES	#9501402	Zn(CO3)2-2
H3BO3	89.4	PERCENT BOUND IN SPECIES	# 90	H3BO3
	10.6	PERCENT BOUND IN SPECIES	#3300900	H2BO3 -1
Ba+2	100.0	PERCENT BOUND IN SPECIES	# 100	Ba+2
Be+2	100.0	PERCENT BOUND IN SPECIES	# 110	Be+2
Fe+2	94.9	PERCENT BOUND IN SPECIES	# 280	Fe+2
	5.1	PERCENT BOUND IN SPECIES	#2803300	FeOH +
Mg+2	98.4	PERCENT BOUND IN SPECIES	# 460	Mg+2
Sr+2	100.0	PERCENT BOUND IN SPECIES	# 800	Sr+2
SeO4-2	100.0	PERCENT BOUND IN SPECIES	# 762	SeO4-2
Al+3	95.3	PERCENT BOUND IN SPECIES	# 303302	Al(OH)4 -
	4.6	PERCENT BOUND IN SPECIES	# 303303	Al(OH)3 AQ
E-1				
CO3-2	1.0	PERCENT BOUND IN SPECIES	# 140	CO3-2
	96.7	PERCENT BOUND IN SPECIES	#3301400	HCO3 -
	1.1	PERCENT BOUND IN SPECIES	#3301401	H2CO3 AQ
PO4-3	13.3	PERCENT BOUND IN SPECIES	#1505800	CaHPO4 AQ
	6.5	PERCENT BOUND IN SPECIES	#1505801	CaPO4 -
	73.5	PERCENT BOUND IN SPECIES	#3305800	HPO4 -2
	5.3	PERCENT BOUND IN SPECIES	#3305801	H2PO4 -
Fe+3	13.0	PERCENT BOUND IN SPECIES	#2813301	FeOH2 +
	28.5	PERCENT BOUND IN SPECIES	#2813302	FeOH3 AQ
	58.5	PERCENT BOUND IN SPECIES	#2813303	FeOH4 -
Na+1	99.9	PERCENT BOUND IN SPECIES	# 500	Na+1
Ca+2	98.2	PERCENT BOUND IN SPECIES	# 150	Ca+2
Mn+3	100.0	PERCENT BOUND IN SPECIES	# 471	Mn+3
H2O	55.2	PERCENT BOUND IN SPECIES	#3300020	OH-
	1.6	PERCENT BOUND IN SPECIES	# 303302	Al(OH)4 -
	7.9	PERCENT BOUND IN SPECIES	#9503300	ZnOH +
	34.1	PERCENT BOUND IN SPECIES	#9503301	Zn(OH)2 AQ

---------- EQUILIBRATED MASS DISTRIBUTION ----------

IDX	NAME	DISSOLVED		SORBED		PRECIPITATED	
		MOL/KG	PERCENT	MOL/KG	PERCENT	MOL/KG	PERCENT
330	H+1	9.792E-04	100.0	0.000E-01	0.0	0.000E-01	0.0
180	Cl-1	5.077E-05	100.0	0.000E-01	0.0	0.000E-01	0.0
270	F-1	1.106E-07	100.0	0.000E-01	0.0	0.000E-01	0.0
950	Zn+2	5.354E-06	100.0	0.000E-01	0.0	0.000E-01	0.0
90	H3BO3	2.313E-05	100.0	0.000E-01	0.0	0.000E-01	0.0
100	Ba+2	2.767E-06	100.0	0.000E-01	0.0	0.000E-01	0.0
110	Be+2	1.110E-07	100.0	0.000E-01	0.0	0.000E-01	0.0
280	Fe+2	1.791E-07	100.0	0.000E-01	0.0	0.000E-01	0.0
460	Mg+2	2.408E-05	100.0	0.000E-01	0.0	0.000E-01	0.0
800	Sr+2	2.397E-06	100.0	0.000E-01	0.0	0.000E-01	0.0
762	SeO4-2	3.498E-07	100.0	0.000E-01	0.0	0.000E-01	0.0
30	Al+3	1.608E-08	0.1	0.000E-01	0.0	1.259E-05	99.9
1	E-1	0.000E-01	0.0	0.000E-01	0.0	0.000E-01	0.0
140	CO3-2	9.931E-04	100.0	0.000E-01	0.0	0.000E-01	0.0
580	PO4-3	2.737E-08	100.0	0.000E-01	0.0	0.000E-01	0.0
281	Fe+3	8.732E-16	100.0	0.000E-01	0.0	0.000E-01	0.0
500	Na+1	3.465E-04	100.0	0.000E-01	0.0	0.000E-01	0.0
150	Ca+2	4.882E-04	100.0	0.000E-01	0.0	0.000E-01	0.0
471	Mn+3	9.965E-26	0.0	0.000E-01	0.0	2.366E-06	100.0
2	H2O	3.738E-06	100.0	0.000E-01	0.0	0.000E-01	0.0

Charge Balance: SPECIATED

Sum of CATIONS = 1.371E-03 Sum of ANIONS 1.037E-03

PERCENT DIFFERENCE = 1.387E+01 (ANIONS - CATIONS)/(ANIONS + CATIONS)

NON-CARBONATE ALKALINITY = 2.077E-06

EQUILIBRIUM IONIC STRENGTH (m) = 1.725E-03

EQUILIBRIUM pH = 8.292

EQUILIBRIUM pe = -6.999 or Eh = -414.03 mv

DATE ID NUMBER: 960924
TIME ID NUMBER: 9180675

APPENDIX D

MODEL OUTPUT FOR EQUILIBRATION OF 1312 LEACHATE - SAMPLE E-4 GRAVEL

```
EQUILIBRATION OF 1312 LEACHATE - SAMPLE E-4 GRAVEL
pCO2=10E-3.5; INFINITE CALCITE, APATITE

25.00 MG/L   0.000  0.00000E-01
0 0 1 2 3 0 0 0 1 2 0 0 0
0   0   0
    330  6.215E-06   -8.21 y                  /H+1
    180  2.300E+00   -4.29 y                  /Cl-1
    270  2.000E-01   -4.98 y                  /F-1
    580  7.000E-02   -6.68 y                  /PO4-3
     30  1.100E-01   -4.90 y                  /Al+3
    100  2.400E-01   -5.56 y                  /Ba+2
    150  2.700E+01   -3.46 y                  /Ca+2
    460  7.000E-01   -3.00 y                  /Mg+2
    762  7.000E-02   -6.46 y                  /SeO4-2
    500  2.100E+01   -3.46                    /Na+1
    800  9.000E-02   -5.62 y                  /Sr+2
    950  2.100E-01   -5.27 y                  /Zn+2
     90  1.144E+00   -4.64 y                  /H3BO3
    732  2.400E+01   -3.60 y                  /SO4-2
     61  1.895E-02   -6.87 y                  /H3AsO4
    600  1.700E-02   -7.09 y                  /Pb+2
    471  9.000E-02   -5.79 y                  /Mn+3
    140  2.400E+01   -6.12 y                  /TOTAL CARBON, CO3

  3   4
3301403    21.6600    -0.5300                /CO2 (g)
5015001     8.4750     2.5850                /CALCITE
7015003    44.1990     0.0000                /HYDRAPATITE
7015002   114.4000   -39.3900                /FCO3APATITE
  6   2
5015000     8.3600     2.6150                /ARAGONITE
5015002    17.0000     8.2900                /DOLOMITE
```

EQUILIBRATION OF 1312 LEACHATE - SAMPLE E-4 GRAVEL
pCO2=10E-3.5; INFINITE CALCITE, APATITE

Temperature (Celsius): 25.00
Units of concentration: MG/L
Ionic strength to be computed.
If specified, carbonate concentration represents total inorganic carbon.
Do not automatically terminate if charge imbalance exceeds 30%
Precipitation is allowed for all solids in the thermodynamic database and
the print option for solids is set to: 2
The maximum number of iterations is: 200
The method used to compute activity coefficients is: Davies equation
Abbreviated output file

330	6.215E-06	-8.21 y
180	2.300E+00	-4.29 y
270	2.000E-01	-4.98 y
580	7.000E-02	-6.68 y
30	1.100E-01	-4.90 y
100	2.400E-01	-5.56 y
150	2.700E+01	-3.46 y
460	7.000E-01	-3.00 y
762	7.000E-02	-6.46 y
500	2.100E+01	-3.46
800	9.000E-02	-5.62 y
950	2.100E-01	-5.27 y
90	1.144E+00	-4.64 y
732	2.400E+01	-3.60 y
61	1.895E-02	-6.87 y
600	1.700E-02	-7.09 y
471	9.000E-02	-5.79 y
140	2.400E+01	-6.12 y

H2O has been inserted as a COMPONENT

3	4	
3301403	21.6600	-0.5300
5015001	8.4750	2.5850
7015003	44.1990	0.0000
7015002	114.4000	-39.3900
6	2	
5015000	8.3600	2.6150
5015002	17.0000	8.2900

Charge Balance: UNSPECIATED

Sum of CATIONS= 2.348E-03 Sum of ANIONS = 1.378E-03

PERCENT DIFFERENCE = 2.602E+01 (ANIONS - CATIONS)/(ANIONS + CATIONS)

IMPROVED ACTIVITY GUESSES PRIOR TO FIRST ITERATION:

PO4-3	Log activity guess:	-10.31
Al+3	Log activity guess:	-15.26
SeO4-2	Log activity guess:	-6.31
SO4-2	Log activity guess:	-3.60
H3AsO4	Log activity guess:	-14.31
CO3-2	Log activity guess:	-5.24

PARAMETERS OF THE COMPONENT MOST OUT OF BALANCE:

ITER	NAME	TOTAL MOL	DIFF FXN	LOG ACTVTY	RESIDUAL
0	SO4-2	2.499E-04	7.439E-05	-3.60229	7.437E-05
1	SO4-2	2.499E-04	5.332E-05	-3.51959	5.329E-05
2	SO4-2	2.499E-04	4.572E-03	-3.60843	4.572E-03
3	SO4-2	2.499E-04	2.357E-03	-3.65143	2.356E-03
4	SO4-2	2.499E-04	1.032E-03	-3.76727	1.032E-03
5	SO4-2	2.499E-04	4.809E-04	-3.93975	4.809E-04
6	SO4-2	2.499E-04	2.232E-04	-4.06156	2.232E-04
7	SO4-2	2.499E-04	2.190E-05	-4.11354	2.188E-05
8	SO4-2	2.499E-04	-4.107E-05	-4.05559	4.104E-05
9	SO4-2	2.499E-04	-3.979E-05	-3.93750	3.976E-05
10	SO4-2	2.499E-04	-2.596E-05	-3.84398	2.593E-05
11	SO4-2	2.499E-04	-1.416E-05	-3.78913	1.414E-05
12	SO4-2	2.499E-04	-6.722E-06	-3.76147	6.697E-06
13	SO4-2	2.499E-04	-2.727E-06	-3.74911	2.702E-06
14	Mg+2	-3.366E-04	-5.189E-06	-4.66936	5.152E-06
15	Mg+2	-3.366E-04	-4.143E-08	-4.66936	4.996E-09
17	SO4-2	2.499E-04	-8.295E-07	-3.74436	8.045E-07
18	SO4-2	2.499E-04	-2.771E-08	-3.74299	2.726E-09

ID	NAME	ANAL MOL	CALC MOL	LOG ACTVTY	GAMMA	DIFF FXN
330	H+1	6.166E-09	6.299E-09	-8.22613	0.943147	1.021E-09
180	Cl-1	6.488E-05	6.488E-05	-4.21331	0.943147	-7.063E-11
270	F-1	1.053E-05	8.431E-08	-7.09955	0.943147	6.756E-09
61	H3AsO4	1.335E-07	3.629E-15	-14.43987	1.000650	-5.711E-13
30	Al+3	4.077E-06	7.683E-16	-15.34328	0.590491	-4.252E-12
100	Ba+2	1.748E-06	1.748E-06	-5.85923	0.791256	-7.610E-12
600	Pb+2	8.206E-08	8.984E-10	-9.14822	0.791256	-1.179E-14
460	Mg+2	2.880E-05	2.716E-05	-4.66781	0.791256	2.738E-10
762	SeO4-2	4.897E-07	4.896E-07	-6.41181	0.791256	-2.132E-12
471	Mn+3	1.638E-06	1.638E-06	-6.01438	0.590491	-1.605E-11
800	Sr+2	1.027E-06	1.027E-06	-6.09001	0.791256	-4.473E-12
950	Zn+2	3.213E-06	1.194E-06	-6.02471	0.791256	-6.319E-12
90	H3BO3	1.850E-05	1.678E-05	-4.77488	1.000650	-1.438E-12
732	SO4-2	2.499E-04	2.284E-04	-3.74295	0.791256	-9.948E-10
580	PO4-3	7.371E-07	1.581E-12	-12.02975	0.590491	0.000E-01
150	Ca+2	6.737E-04	6.831E-04	-3.26717	0.791256	0.000E-01
500	Na+1	9.135E-04	9.107E-04	-3.06604	0.943147	-8.528E-22
2	H2O	0.000E-01	-4.353E-04	-0.00002	1.000000	0.000E-01
140	CO3-2	4.000E-04	7.833E-06	-5.20776	0.791256	4.388E-22

PERCENTAGE DISTRIBUTION OF COMPONENTS AMONG
TYPE I and TYPE II (dissolved and adsorbed) species

H+1	99.3	PERCENT BOUND IN SPECIES #3301400	HCO3 -
	2.5	PERCENT BOUND IN SPECIES #3301401	H2CO3 AQ
Cl-1	100.0	PERCENT BOUND IN SPECIES # 180	Cl-1
F-1	99.4	PERCENT BOUND IN SPECIES # 270	F-1
H3AsO4	2.8	PERCENT BOUND IN SPECIES #3300611	H2AsO4 -
	97.2	PERCENT BOUND IN SPECIES #3300612	HAsO4 -2
Al+3	94.7	PERCENT BOUND IN SPECIES # 303302	Al(OH)4 -
	5.3	PERCENT BOUND IN SPECIES # 303303	Al(OH)3 AQ
Ba+2	100.0	PERCENT BOUND IN SPECIES # 100	Ba+2
Pb+2	1.1	PERCENT BOUND IN SPECIES # 600	Pb+2
	1.8	PERCENT BOUND IN SPECIES #6001400	Pb(CO3)2-2
	3.0	PERCENT BOUND IN SPECIES #6003300	PbOH +
	93.2	PERCENT BOUND IN SPECIES #6001401	PbCO3 AQ
Mg+2	96.3	PERCENT BOUND IN SPECIES # 460	Mg+2
	2.4	PERCENT BOUND IN SPECIES #4607320	MgSO4 AQ
SeO4-2	100.0	PERCENT BOUND IN SPECIES # 762	SeO4-2
Mn+3	100.0	PERCENT BOUND IN SPECIES # 471	Mn+3
Sr+2	100.0	PERCENT BOUND IN SPECIES # 800	Sr+2
Zn+2	37.2	PERCENT BOUND IN SPECIES # 950	Zn+2
	5.8	PERCENT BOUND IN SPECIES #9503300	ZnOH +
	10.5	PERCENT BOUND IN SPECIES #9503301	Zn(OH)2 AQ
	1.2	PERCENT BOUND IN SPECIES #9507320	ZnSO4 AQ
	2.9	PERCENT BOUND IN SPECIES #9501400	ZnHCO3 +
	36.3	PERCENT BOUND IN SPECIES #9501401	ZnCO3 AQ
	6.1	PERCENT BOUND IN SPECIES #9501402	Zn(CO3)2-2
H3BO3	90.7	PERCENT BOUND IN SPECIES # 90	H3BO3
	9.3	PERCENT BOUND IN SPECIES #3300900	H2BO3 -1
SO4-2	91.4	PERCENT BOUND IN SPECIES # 732	SO4-2
	8.0	PERCENT BOUND IN SPECIES #1507320	CaSO4 AQ
PO4-3	16.3	PERCENT BOUND IN SPECIES #1505800	CaHPO4 AQ
	6.9	PERCENT BOUND IN SPECIES #1505801	CaPO4 -
	69.7	PERCENT BOUND IN SPECIES #3305800	HPO4 -2
	5.6	PERCENT BOUND IN SPECIES #3305801	H2PO4 -
Ca+2	95.9	PERCENT BOUND IN SPECIES # 150	Ca+2
	2.8	PERCENT BOUND IN SPECIES #1507320	CaSO4 AQ
Na+1	99.9	PERCENT BOUND IN SPECIES # 500	Na+1
H2O	9.5	PERCENT BOUND IN SPECIES #3300020	OH-
	82.2	PERCENT BOUND IN SPECIES # 303302	Al(OH)4 -
	3.5	PERCENT BOUND IN SPECIES # 303303	Al(OH)3 AQ
	3.6	PERCENT BOUND IN SPECIES #9503301	Zn(OH)2 AQ
CO3-2	96.5	PERCENT BOUND IN SPECIES #3301400	HCO3 -
	1.2	PERCENT BOUND IN SPECIES #3301401	H2CO3 AQ

---------- PROVISIONAL MASS DISTRIBUTION ----------

IDX	NAME	DISSOLVED		SORBED		PRECIPITATED	
		MOL/KG	PERCENT	MOL/KG	PERCENT	MOL/KG	PERCENT
330	H+1	8.395E-04	100.0	0.000E-01	0.0	0.000E-01	0.0
180	Cl-1	6.488E-05	100.0	0.000E-01	0.0	0.000E-01	0.0
270	F-1	8.484E-08	100.0	0.000E-01	0.0	0.000E-01	0.0
61	H3AsO4	1.335E-07	100.0	0.000E-01	0.0	0.000E-01	0.0
30	Al+3	4.077E-06	100.0	0.000E-01	0.0	0.000E-01	0.0
100	Ba+2	1.748E-06	100.0	0.000E-01	0.0	0.000E-01	0.0
600	Pb+2	8.206E-08	100.0	0.000E-01	0.0	0.000E-01	0.0
460	Mg+2	2.819E-05	100.0	0.000E-01	0.0	0.000E-01	0.0
762	SeO4-2	4.897E-07	100.0	0.000E-01	0.0	0.000E-01	0.0
471	Mn+3	1.638E-06	100.0	0.000E-01	0.0	0.000E-01	0.0
800	Sr+2	1.027E-06	100.0	0.000E-01	0.0	0.000E-01	0.0
950	Zn+2	3.213E-06	100.0	0.000E-01	0.0	0.000E-01	0.0
90	H3BO3	1.850E-05	100.0	0.000E-01	0.0	0.000E-01	0.0
732	SO4-2	2.499E-04	100.0	0.000E-01	0.0	0.000E-01	0.0
580	PO4-3	2.231E-08	100.0	0.000E-01	0.0	0.000E-01	0.0
150	Ca+2	7.125E-04	100.0	0.000E-01	0.0	0.000E-01	0.0
500	Na+1	9.120E-04	100.0	0.000E-01	0.0	0.000E-01	0.0
2	H2O	1.878E-05	100.0	0.000E-01	0.0	0.000E-01	0.0
140	CO3-2	8.642E-04	100.0	0.000E-01	0.0	0.000E-01	0.0

Charge Balance: SPECIATED

Sum of CATIONS = 2.349E-03 Sum of ANIONS 1.381E-03

PERCENT DIFFERENCE = 2.595E+01 (ANIONS - CATIONS)/(ANIONS + CATIONS)

PROVISIONAL IONIC STRENGTH (m) = 2.822E-03

PC MINTEQA2 v3.10 DATE OF CALCULATIONS: 25-SEP-96 TIME: 11:12:17

ITERATIONS= 19: SOLID BIXBYITE PRECIPITATES

PART 3 of OUTPUT FILE

PC MINTEQA2 v3.10 DATE OF CALCULATIONS: 25-SEP-96 TIME: 11:12:17

PARAMETERS OF THE COMPONENT MOST OUT OF BALANCE:

ITER	NAME	TOTAL MOL	DIFF FXN	LOG ACTVTY	RESIDUAL
19	H3BO3	1.850E-05	-8.696E-08	-4.77488	8.511E-08
20	H3BO3	1.850E-05	8.625E-08	-4.76997	8.440E-08
21	H3BO3	1.850E-05	8.765E-09	-4.77449	6.915E-09
22	Zn+2	3.213E-06	-1.149E-09	-6.02422	8.274E-10

ID	NAME	ANAL MOL	CALC MOL	LOG ACTVTY	GAMMA	DIFF FXN
330	H+1	6.166E-09	6.308E-09	-8.22554	0.943188	5.547E-09
180	Cl-1	6.488E-05	6.488E-05	-4.21329	0.943188	-1.005E-09
270	F-1	1.053E-05	8.420E-08	-7.10008	0.943188	8.617E-08
61	H3AsO4	1.335E-07	3.640E-15	-14.43865	1.000649	-8.150E-12
30	Al+3	4.077E-06	7.721E-16	-15.34092	0.590724	-6.028E-11
100	Ba+2	1.748E-06	1.748E-06	-5.85918	0.791395	-1.082E-10
600	Pb+2	8.206E-08	9.007E-10	-9.14705	0.791395	-1.705E-13
460	Mg+2	2.880E-05	2.716E-05	-4.66775	0.791395	3.319E-09
762	SeO4-2	4.897E-07	4.896E-07	-6.41176	0.791395	-3.032E-11
732	SO4-2	2.499E-04	2.284E-04	-3.74300	0.791395	-1.414E-08
800	Sr+2	1.027E-06	1.027E-06	-6.08995	0.791395	-6.362E-11
950	Zn+2	3.213E-06	1.196E-06	-6.02394	0.791395	-9.011E-11
90	H3BO3	1.850E-05	1.678E-05	-4.77482	1.000649	-2.037E-11
471	Mn+3	1.638E-06	1.764E-25	-24.98208	0.590724	-1.609E-20
580	PO4-3	7.371E-07	1.574E-12	-12.03154	0.590724	-1.236E-20
500	Na+1	9.135E-04	9.107E-04	-3.06603	0.943188	1.431E-22
150	Ca+2	6.737E-04	6.849E-04	-3.26598	0.791395	0.000E-01
140	CO3-2	4.000E-04	7.810E-06	-5.20895	0.791395	3.739E-22
2	H2O	0.000E-01	-4.346E-04	-0.00002	1.000000	-1.059E-22

PERCENTAGE DISTRIBUTION OF COMPONENTS AMONG
TYPE I and TYPE II (dissolved and adsorbed) species

H+1	99.3	PERCENT BOUND IN SPECIES	#3301400	HCO3 -
2.5	PERCENT BOUND IN SPECIES	#3301401	H2CO3 AQ	
Cl-1	100.0	PERCENT BOUND IN SPECIES	# 180	Cl-1
F-1	99.4	PERCENT BOUND IN SPECIES	# 270	F-1
H3AsO4	2.8	PERCENT BOUND IN SPECIES	#3300611	H2AsO4 -
97.2	PERCENT BOUND IN SPECIES	#3300612	HAsO4 -2	
Al+3	94.7	PERCENT BOUND IN SPECIES	# 303302	Al(OH)4 -
5.3	PERCENT BOUND IN SPECIES	# 303303	Al(OH)3 AQ	
Ba+2	100.0	PERCENT BOUND IN SPECIES	# 100	Ba+2
Pb+2	1.1	PERCENT BOUND IN SPECIES	# 600	Pb+2
1.8	PERCENT BOUND IN SPECIES	#6001400	Pb(CO3)2-2	
3.0	PERCENT BOUND IN SPECIES	#6003300	PbOH +	
93.2	PERCENT BOUND IN SPECIES	#6001401	PbCO3 AQ	
Mg+2	96.3	PERCENT BOUND IN SPECIES	# 460	Mg+2
2.4	PERCENT BOUND IN SPECIES	#4607320	MgSO4 AQ	
SeO4-2	100.0	PERCENT BOUND IN SPECIES	# 762	SeO4-2
SO4-2	91.4	PERCENT BOUND IN SPECIES	# 732	SO4-2
8.0	PERCENT BOUND IN SPECIES	#1507320	CaSO4 AQ	
Sr+2	100.0	PERCENT BOUND IN SPECIES	# 800	Sr+2
Zn+2	37.2	PERCENT BOUND IN SPECIES	# 950	Zn+2
5.8	PERCENT BOUND IN SPECIES	#9503300	ZnOH +	
10.5	PERCENT BOUND IN SPECIES	#9503301	Zn(OH)2 AQ	
1.2	PERCENT BOUND IN SPECIES	#9507320	ZnSO4 AQ	
2.9	PERCENT BOUND IN SPECIES	#9501400	ZnHCO3 +	
36.3	PERCENT BOUND IN SPECIES	#9501401	ZnCO3 AQ	
6.1	PERCENT BOUND IN SPECIES	#9501402	Zn(CO3)2-2	
H3BO3	90.7	PERCENT BOUND IN SPECIES	# 90	H3BO3
9.3	PERCENT BOUND IN SPECIES	#3300900	H2BO3 -1	
Mn+3	100.0	PERCENT BOUND IN SPECIES	# 471	Mn+3
PO4-3	16.4	PERCENT BOUND IN SPECIES	#1505800	CaHPO4 AQ
6.9	PERCENT BOUND IN SPECIES	#1505801	CaPO4 -	
69.7	PERCENT BOUND IN SPECIES	#3305800	HPO4 -2	
5.6	PERCENT BOUND IN SPECIES	#3305801	H2PO4 -	
Na+1	99.9	PERCENT BOUND IN SPECIES	# 500	Na+1
Ca+2	95.9	PERCENT BOUND IN SPECIES	# 150	Ca+2
2.8	PERCENT BOUND IN SPECIES	#1507320	CaSO4 AQ	
CO3-2	96.5	PERCENT BOUND IN SPECIES	#3301400	HCO3 -
1.2	PERCENT BOUND IN SPECIES	#3301401	H2CO3 AQ	
H2O	9.5	PERCENT BOUND IN SPECIES	#3300020	OH-
82.2	PERCENT BOUND IN SPECIES	# 303302	Al(OH)4 -	
3.5	PERCENT BOUND IN SPECIES	# 303303	Al(OH)3 AQ	
3.6	PERCENT BOUND IN SPECIES	#9503301	Zn(OH)2 AQ	

---------- PROVISIONAL MASS DISTRIBUTION ----------

IDX	NAME	DISSOLVED		SORBED		PRECIPITATED	
		MOL/KG	PERCENT	MOL/KG	PERCENT	MOL/KG	PERCENT
330	H+1	8.383E-04	100.0	0.000E-01	0.0	0.000E-01	0.0
180	Cl-1	6.488E-05	100.0	0.000E-01	0.0	0.000E-01	0.0
270	F-1	8.473E-08	100.0	0.000E-01	0.0	0.000E-01	0.0
61	H3AsO4	1.335E-07	100.0	0.000E-01	0.0	0.000E-01	0.0
30	Al+3	4.077E-06	100.0	0.000E-01	0.0	0.000E-01	0.0
100	Ba+2	1.748E-06	100.0	0.000E-01	0.0	0.000E-01	0.0
600	Pb+2	8.206E-08	100.0	0.000E-01	0.0	0.000E-01	0.0
460	Mg+2	2.819E-05	100.0	0.000E-01	0.0	0.000E-01	0.0
762	SeO4-2	4.897E-07	100.0	0.000E-01	0.0	0.000E-01	0.0
732	SO4-2	2.499E-04	100.0	0.000E-01	0.0	0.000E-01	0.0
800	Sr+2	1.027E-06	100.0	0.000E-01	0.0	0.000E-01	0.0
950	Zn+2	3.213E-06	100.0	0.000E-01	0.0	0.000E-01	0.0
90	H3BO3	1.850E-05	100.0	0.000E-01	0.0	0.000E-01	0.0
471	Mn+3	1.764E-25	0.0	0.000E-01	0.0	1.638E-06	100.0
580	PO4-3	2.226E-08	100.0	0.000E-01	0.0	0.000E-01	0.0
500	Na+1	9.120E-04	100.0	0.000E-01	0.0	0.000E-01	0.0
150	Ca+2	7.143E-04	100.0	0.000E-01	0.0	0.000E-01	0.0
140	CO3-2	8.630E-04	100.0	0.000E-01	0.0	0.000E-01	0.0
2	H2O	1.877E-05	100.0	0.000E-01	0.0	0.000E-01	0.0

Charge Balance: SPECIATED

Sum of CATIONS = 2.348E-03 Sum of ANIONS 1.380E-03

PERCENT DIFFERENCE = 2.597E+01 (ANIONS - CATIONS)/(ANIONS + CATIONS)

PROVISIONAL IONIC STRENGTH (m) = 2.817E-03

PC MINTEQA2 v3.10 DATE OF CALCULATIONS: 25-SEP-96 TIME: 11:12:17

ITERATIONS= 23: SOLID BA(ASO4)2 PRECIPITATES

PARAMETERS OF THE COMPONENT MOST OUT OF BALANCE:

ITER	NAME	TOTAL MOL	DIFF FXN	LOG ACTVTY	RESIDUAL
23	Zn+2	3.213E-06	-3.050E-07	-6.02394	3.047E-07
24	Zn+2	3.213E-06	3.232E-07	-5.94434	3.228E-07
25	Zn+2	3.213E-06	-5.613E-09	-6.02294	5.292E-09
26	Zn+2	3.213E-06	-1.158E-09	-6.02409	8.368E-10
27	H3AsO4	-1.032E-06	9.690E-07	-18.43865	9.689E-07
28	H3AsO4	-1.032E-06	7.408E-07	-19.43865	7.407E-07
29	Sr+2	1.027E-06	1.276E-10	-6.08988	2.487E-11
30	H3AsO4	-1.032E-06	-7.147E-08	-20.30717	7.135E-08
31	H3AsO4	-1.032E-06	-5.321E-09	-20.26688	5.217E-09

ID	NAME	ANAL MOL	CALC MOL	LOG ACTVTY	GAMMA	DIFF FXN
330	H+1	6.166E-09	6.308E-09	-8.22551	0.943194	3.215E-10
180	Cl-1	6.488E-05	6.488E-05	-4.21328	0.943194	-1.467E-11
270	F-1	1.053E-05	8.420E-08	-7.10011	0.943194	1.420E-09
61	H3AsO4	1.335E-07	5.447E-21	-20.26355	1.000649	-3.301E-11
30	Al+3	4.077E-06	7.723E-16	-15.34080	0.590758	-8.722E-13
90	H3BO3	1.850E-05	1.678E-05	-4.77482	1.000649	-2.987E-13
600	Pb+2	8.206E-08	9.008E-10	-9.14699	0.791415	-2.423E-15
460	Mg+2	2.880E-05	2.716E-05	-4.66771	0.791415	5.783E-11
762	SeO4-2	4.897E-07	4.896E-07	-6.41172	0.791415	-4.429E-13
732	SO4-2	2.499E-04	2.284E-04	-3.74297	0.791415	-2.067E-10
800	Sr+2	1.027E-06	1.027E-06	-6.08992	0.791415	-9.293E-13
950	Zn+2	3.213E-06	1.196E-06	-6.02388	0.791415	-1.313E-12
2	H2O	3.775E-19	-4.346E-04	-0.00002	1.000000	0.000E-01
140	CO3-2	4.000E-04	7.809E-06	-5.20900	0.791415	0.000E-01
580	PO4-3	7.371E-07	1.574E-12	-12.03162	0.590758	-3.160E-22
500	Na+1	9.135E-04	9.107E-04	-3.06602	0.943194	1.758E-24
150	Ca+2	6.737E-04	6.850E-04	-3.26593	0.791415	1.555E-22
471	Mn+3	1.638E-06	1.764E-25	-24.98200	0.590758	0.000E-01
100	Ba+2	1.748E-06	1.547E-06	-5.91199	0.791415	0.000E-01

PERCENTAGE DISTRIBUTION OF COMPONENTS AMONG
TYPE I and TYPE II (dissolved and adsorbed) species

H+1	99.3	PERCENT BOUND IN SPECIES #3301400	HCO3 -	
2.5	PERCENT BOUND IN SPECIES #3301401	H2CO3 AQ		
Cl-1	100.0	PERCENT BOUND IN SPECIES # 180	Cl-1	
F-1	99.4	PERCENT BOUND IN SPECIES # 270	F-1	
H3AsO4	2.8	PERCENT BOUND IN SPECIES #3300611	H2AsO4 -	
97.2	PERCENT BOUND IN SPECIES #3300612	HAsO4 -2		
Al+3	94.7	PERCENT BOUND IN SPECIES # 303302	Al(OH)4 -	
5.3	PERCENT BOUND IN SPECIES # 303303	Al(OH)3 AQ		
H3BO3	90.7	PERCENT BOUND IN SPECIES # 90	H3BO3	
9.3	PERCENT BOUND IN SPECIES #3300900	H2BO3 -1		
Pb+2	1.1	PERCENT BOUND IN SPECIES # 600	Pb+2	
1.8	PERCENT BOUND IN SPECIES #6001400	Pb(CO3)2-2		
3.0	PERCENT BOUND IN SPECIES #6003300	PbOH +		
93.2	PERCENT BOUND IN SPECIES #6001401	PbCO3 AQ		
Mg+2	96.3	PERCENT BOUND IN SPECIES # 460	Mg+2	
2.4	PERCENT BOUND IN SPECIES #4607320	MgSO4 AQ		
SeO4-2	100.0	PERCENT BOUND IN SPECIES # 762	SeO4-2	
SO4-2	91.4	PERCENT BOUND IN SPECIES # 732	SO4-2	
8.0	PERCENT BOUND IN SPECIES #1507320	CaSO4 AQ		
Sr+2	100.0	PERCENT BOUND IN SPECIES # 800	Sr+2	
Zn+2	37.2	PERCENT BOUND IN SPECIES # 950	Zn+2	
5.8	PERCENT BOUND IN SPECIES #9503300	ZnOH +		
10.5	PERCENT BOUND IN SPECIES #9503301	Zn(OH)2 AQ		
1.2	PERCENT BOUND IN SPECIES #9507320	ZnSO4 AQ		
2.9	PERCENT BOUND IN SPECIES #9501400	ZnHCO3 +		
36.3	PERCENT BOUND IN SPECIES #9501401	ZnCO3 AQ		
6.1	PERCENT BOUND IN SPECIES #9501402	Zn(CO3)2-2		
H2O	9.5	PERCENT BOUND IN SPECIES #3300020	OH-	
82.2	PERCENT BOUND IN SPECIES # 303302	Al(OH)4 -		
3.5	PERCENT BOUND IN SPECIES # 303303	Al(OH)3 AQ		
3.6	PERCENT BOUND IN SPECIES #9503301	Zn(OH)2 AQ		
CO3-2	96.5	PERCENT BOUND IN SPECIES #3301400	HCO3 -	
1.2	PERCENT BOUND IN SPECIES #3301401	H2CO3 AQ		
PO4-3	16.4	PERCENT BOUND IN SPECIES #1505800	CaHPO4 AQ	
6.9	PERCENT BOUND IN SPECIES #1505801	CaPO4 -		
69.7	PERCENT BOUND IN SPECIES #3305800	HPO4 -2		
5.6	PERCENT BOUND IN SPECIES #3305801	H2PO4 -		
Na+1	99.9	PERCENT BOUND IN SPECIES # 500	Na+1	
Ca+2	95.9	PERCENT BOUND IN SPECIES # 150	Ca+2	
2.8	PERCENT BOUND IN SPECIES #1507320	CaSO4 AQ		
Mn+3	100.0	PERCENT BOUND IN SPECIES # 471	Mn+3	
Ba+2	100.0	PERCENT BOUND IN SPECIES # 100	Ba+2	

PART 5 of OUTPUT FILE

PC MINTEQA2 v3.10 DATE OF CALCULATIONS: 25-SEP-96 TIME: 11:12:18

---------- PROVISIONAL MASS DISTRIBUTION ----------

IDX	NAME	DISSOLVED		SORBED		PRECIPITATED	
		MOL/KG	PERCENT	MOL/KG	PERCENT	MOL/KG	PERCENT
330	H+1	8.385E-04	100.0	0.000E-01	0.0	0.000E-01	0.0
180	Cl-1	6.488E-05	100.0	0.000E-01	0.0	0.000E-01	0.0
270	F-1	8.473E-08	100.0	0.000E-01	0.0	0.000E-01	0.0
61	H3AsO4	1.998E-13	0.0	0.000E-01	0.0	1.335E-07	100.0
30	Al+3	4.077E-06	100.0	0.000E-01	0.0	0.000E-01	0.0
90	H3BO3	1.850E-05	100.0	0.000E-01	0.0	0.000E-01	0.0
600	Pb+2	8.206E-08	100.0	0.000E-01	0.0	0.000E-01	0.0
460	Mg+2	2.819E-05	100.0	0.000E-01	0.0	0.000E-01	0.0
762	SeO4-2	4.897E-07	100.0	0.000E-01	0.0	0.000E-01	0.0
732	SO4-2	2.499E-04	100.0	0.000E-01	0.0	0.000E-01	0.0
800	Sr+2	1.027E-06	100.0	0.000E-01	0.0	0.000E-01	0.0
950	Zn+2	3.213E-06	100.0	0.000E-01	0.0	0.000E-01	0.0
2	H2O	1.877E-05	100.0	0.000E-01	0.0	0.000E-01	0.0
140	CO3-2	8.629E-04	100.0	0.000E-01	0.0	0.000E-01	0.0
580	PO4-3	2.225E-08	100.0	0.000E-01	0.0	0.000E-01	0.0
500	Na+1	9.120E-04	100.0	0.000E-01	0.0	0.000E-01	0.0
150	Ca+2	7.144E-04	100.0	0.000E-01	0.0	0.000E-01	0.0
471	Mn+3	1.764E-25	0.0	0.000E-01	0.0	1.638E-06	100.0
100	Ba+2	1.547E-06	88.5	0.000E-01	0.0	2.002E-07	11.5

Charge Balance: SPECIATED

Sum of CATIONS = 2.348E-03 Sum of ANIONS 1.380E-03

PERCENT DIFFERENCE = 2.597E+01 (ANIONS - CATIONS)/(ANIONS + CATIONS)

PROVISIONAL IONIC STRENGTH (m) = 2.816E-03

PC MINTEQA2 v3.10 DATE OF CALCULATIONS: 25-SEP-96 TIME: 11:12:18

ITERATIONS= 32: SOLID DIASPORE PRECIPITATES

PARAMETERS OF THE COMPONENT MOST OUT OF BALANCE:

ITER	NAME	TOTAL MOL	DIFF FXN	LOG ACTVTY	RESIDUAL
32	Sr+2	1.027E-06	-2.143E-07	-6.08992	2.142E-07
33	Sr+2	1.027E-06	2.620E-07	-5.98832	2.619E-07
34	Sr+2	1.027E-06	7.674E-09	-6.08699	7.570E-09
35	Sr+2	1.027E-06	-8.376E-10	-6.09022	7.348E-10

ID	NAME	ANAL MOL	CALC MOL	LOG ACTVTY	GAMMA	DIFF FXN
330	H+1	6.166E-09	6.301E-09	-8.22595	0.943234	5.521E-09
180	Cl-1	6.488E-05	6.488E-05	-4.21327	0.943234	-9.917E-10
270	F-1	1.053E-05	8.427E-08	-7.09973	0.943234	8.540E-08
61	H3AsO4	1.335E-07	5.430E-21	-20.26491	1.000648	6.131E-11
950	Zn+2	3.213E-06	1.194E-06	-6.02442	0.791548	-8.889E-11
90	H3BO3	1.850E-05	1.678E-05	-4.77486	1.000648	-2.013E-11
600	Pb+2	8.206E-08	8.988E-10	-9.14785	0.791548	-1.683E-13
460	Mg+2	2.880E-05	2.715E-05	-4.66768	0.791548	3.296E-09
762	SeO4-2	4.897E-07	4.896E-07	-6.41167	0.791548	-2.994E-11
732	SO4-2	2.499E-04	2.284E-04	-3.74285	0.791548	-1.396E-08
800	Sr+2	1.027E-06	1.027E-06	-6.08987	0.791548	-6.280E-11
30	Al+3	4.077E-06	2.652E-18	-17.80480	0.590982	0.000E-01
150	Ca+2	6.737E-04	6.835E-04	-3.26680	0.791548	2.202E-20
140	CO3-2	4.000E-04	7.823E-06	-5.20813	0.791548	0.000E-01
580	PO4-3	7.371E-07	1.578E-12	-12.03030	0.590982	8.470E-22
500	Na+1	9.135E-04	9.107E-04	-3.06600	0.943234	-1.008E-22
471	Mn+3	1.638E-06	1.758E-25	-24.98331	0.590982	0.000E-01
100	Ba+2	1.748E-06	1.547E-06	-5.91195	0.791548	0.000E-01
2	H2O	3.775E-19	-4.290E-04	-0.00002	1.000000	0.000E-01

PERCENTAGE DISTRIBUTION OF COMPONENTS AMONG
TYPE I and TYPE II (dissolved and adsorbed) species

H+1		97.4	PERCENT BOUND IN SPECIES	#3301400	HCO3 -
	2.5	PERCENT BOUND IN SPECIES	#3301401	H2CO3 AQ	
Cl-1		100.0	PERCENT BOUND IN SPECIES	# 180	Cl-1
F-1		99.4	PERCENT BOUND IN SPECIES	# 270	F-1
H3AsO4		2.8	PERCENT BOUND IN SPECIES	#3300611	H2AsO4 -
	97.2	PERCENT BOUND IN SPECIES	#3300612	HAsO4 -2	
Zn+2		37.2	PERCENT BOUND IN SPECIES	# 950	Zn+2
	5.8	PERCENT BOUND IN SPECIES	#9503300	ZnOH +	
	10.5	PERCENT BOUND IN SPECIES	#9503301	Zn(OH)2 AQ	
	1.2	PERCENT BOUND IN SPECIES	#9507320	ZnSO4 AQ	
	2.9	PERCENT BOUND IN SPECIES	#9501400	ZnHCO3 +	
	36.3	PERCENT BOUND IN SPECIES	#9501401	ZnCO3 AQ	
	6.1	PERCENT BOUND IN SPECIES	#9501402	Zn(CO3)2-2	
H3BO3		90.7	PERCENT BOUND IN SPECIES	# 90	H3BO3
	9.3	PERCENT BOUND IN SPECIES	#3300900	H2BO3 -1	
Pb+2		1.1	PERCENT BOUND IN SPECIES	# 600	Pb+2
	1.8	PERCENT BOUND IN SPECIES	#6001400	Pb(CO3)2-2	
	3.0	PERCENT BOUND IN SPECIES	#6003300	PbOH +	
	93.2	PERCENT BOUND IN SPECIES	#6001401	PbCO3 AQ	
Mg+2		96.3	PERCENT BOUND IN SPECIES	# 460	Mg+2
	2.4	PERCENT BOUND IN SPECIES	#4607320	MgSO4 AQ	
SeO4-2		100.0	PERCENT BOUND IN SPECIES	# 762	SeO4-2
SO4-2		91.4	PERCENT BOUND IN SPECIES	# 732	SO4-2
	8.0	PERCENT BOUND IN SPECIES	#1507320	CaSO4 AQ	
Sr+2		100.0	PERCENT BOUND IN SPECIES	# 800	Sr+2
Al+3		94.7	PERCENT BOUND IN SPECIES	# 303302	Al(OH)4 -
	5.3	PERCENT BOUND IN SPECIES	# 303303	Al(OH)3 AQ	
Ca+2		95.9	PERCENT BOUND IN SPECIES	# 150	Ca+2
	2.8	PERCENT BOUND IN SPECIES	#1507320	CaSO4 AQ	
CO3-2		96.5	PERCENT BOUND IN SPECIES	#3301400	HCO3 -
	1.2	PERCENT BOUND IN SPECIES	#3301401	H2CO3 AQ	
PO4-3		16.4	PERCENT BOUND IN SPECIES	#1505800	CaHPO4 AQ
	6.9	PERCENT BOUND IN SPECIES	#1505801	CaPO4 -	
	69.7	PERCENT BOUND IN SPECIES	#3305800	HPO4 -2	
	5.6	PERCENT BOUND IN SPECIES	#3305801	H2PO4 -	
Na+1		99.9	PERCENT BOUND IN SPECIES	# 500	Na+1
Mn+3		100.0	PERCENT BOUND IN SPECIES	# 471	Mn+3
Ba+2		100.0	PERCENT BOUND IN SPECIES	# 100	Ba+2
H2O		65.4	PERCENT BOUND IN SPECIES	#3300020	OH-
	1.9	PERCENT BOUND IN SPECIES	# 303302	Al(OH)4 -	
	6.7	PERCENT BOUND IN SPECIES	#9503300	ZnOH +	
	24.6	PERCENT BOUND IN SPECIES	#9503301	Zn(OH)2 AQ	

---------- PROVISIONAL MASS DISTRIBUTION ----------

IDX	NAME	DISSOLVED		SORBED		PRECIPITATED	
		MOL/KG	PERCENT	MOL/KG	PERCENT	MOL/KG	PERCENT
330	H+1	8.553E-04	100.0	0.000E-01	0.0	0.000E-01	0.0
180	Cl-1	6.488E-05	100.0	0.000E-01	0.0	0.000E-01	0.0
270	F-1	8.480E-08	100.0	0.000E-01	0.0	0.000E-01	0.0
61	H3AsO4	1.995E-13	0.0	0.000E-01	0.0	1.336E-07	100.0
950	Zn+2	3.213E-06	100.0	0.000E-01	0.0	0.000E-01	0.0
90	H3BO3	1.850E-05	100.0	0.000E-01	0.0	0.000E-01	0.0
600	Pb+2	8.206E-08	100.0	0.000E-01	0.0	0.000E-01	0.0
460	Mg+2	2.819E-05	100.0	0.000E-01	0.0	0.000E-01	0.0
762	SeO4-2	4.897E-07	100.0	0.000E-01	0.0	0.000E-01	0.0
732	SO4-2	2.499E-04	100.0	0.000E-01	0.0	0.000E-01	0.0
800	Sr+2	1.027E-06	100.0	0.000E-01	0.0	0.000E-01	0.0
30	Al+3	1.406E-08	0.3	0.000E-01	0.0	4.063E-06	99.7
150	Ca+2	7.128E-04	100.0	0.000E-01	0.0	0.000E-01	0.0
140	CO3-2	8.637E-04	100.0	0.000E-01	0.0	0.000E-01	0.0
580	PO4-3	2.229E-08	100.0	0.000E-01	0.0	0.000E-01	0.0
500	Na+1	9.120E-04	100.0	0.000E-01	0.0	0.000E-01	0.0
471	Mn+3	1.758E-25	0.0	0.000E-01	0.0	1.638E-06	100.0
100	Ba+2	1.547E-06	88.5	0.000E-01	0.0	2.004E-07	11.5
2	H2O	2.741E-06	100.0	0.000E-01	0.0	0.000E-01	0.0

Charge Balance: SPECIATED

Sum of CATIONS = 2.345E-03 Sum of ANIONS 1.377E-03

PERCENT DIFFERENCE = 2.601E+01 (ANIONS - CATIONS)/(ANIONS + CATIONS)

PROVISIONAL IONIC STRENGTH (m) = 2.812E-03
PC MINTEQA2 v3.10 DATE OF CALCULATIONS: 25-SEP-96 TIME: 11:12:20

ITERATIONS= 36: SOLID BARITE PRECIPITATES

PARAMETERS OF THE COMPONENT MOST OUT OF BALANCE:

ITER	NAME	TOTAL MOL	DIFF FXN	LOG ACTVTY	RESIDUAL
36	Sr+2	1.027E-06	-2.142E-07	-6.08987	2.141E-07
37	Sr+2	1.027E-06	2.572E-07	-5.98832	2.571E-07
38	Sr+2	1.027E-06	1.120E-08	-6.08537	1.109E-08
39	Sr+2	1.027E-06	-6.189E-10	-6.09008	5.162E-10

ID	NAME	ANAL MOL	CALC MOL	LOG ACTVTY	GAMMA	DIFF FXN
330	H+1	6.166E-09	6.302E-09	-8.22592	0.943262	2.729E-08
180	Cl-1	6.488E-05	6.488E-05	-4.21326	0.943262	-8.783E-10
270	F-1	1.053E-05	8.426E-08	-7.09976	0.943262	7.274E-08
61	H3AsO4	1.335E-07	1.639E-20	-19.78506	1.000647	-8.279E-09
950	Zn+2	3.213E-06	1.194E-06	-6.02434	0.791644	-7.867E-11
90	H3BO3	1.850E-05	1.678E-05	-4.77485	1.000647	-1.786E-11
600	Pb+2	8.206E-08	8.988E-10	-9.14779	0.791644	-1.473E-13
460	Mg+2	2.880E-05	2.716E-05	-4.66759	0.791644	2.750E-09
762	SeO4-2	4.897E-07	4.896E-07	-6.41162	0.791644	-2.651E-11
800	Sr+2	1.027E-06	1.027E-06	-6.08981	0.791644	-5.563E-11
471	Mn+3	1.638E-06	1.758E-25	-24.98322	0.591143	-1.588E-20
500	Na+1	9.135E-04	9.107E-04	-3.06599	0.943262	1.022E-20
150	Ca+2	6.737E-04	6.835E-04	-3.26674	0.791644	8.230E-22
140	CO3-2	4.000E-04	7.821E-06	-5.20819	0.791644	-2.118E-22
580	PO4-3	7.371E-07	1.577E-12	-12.03040	0.591143	8.867E-22
30	Al+3	4.077E-06	2.652E-18	-17.80471	0.591143	0.000E-01
732	SO4-2	2.499E-04	2.276E-04	-3.74421	0.791644	0.000E-01
2	H2O	3.775E-19	-4.289E-04	-0.00002	1.000000	0.000E-01
100	Ba+2	1.748E-06	7.408E-07	-6.23179	0.791644	0.000E-01

PERCENTAGE DISTRIBUTION OF COMPONENTS AMONG
TYPE I and TYPE II (dissolved and adsorbed) species

H+1	97.4	PERCENT BOUND IN SPECIES	#3301400	HCO3 -
	2.5	PERCENT BOUND IN SPECIES	#3301401	H2CO3 AQ
Cl-1	100.0	PERCENT BOUND IN SPECIES	# 180	Cl-1
F-1	99.4	PERCENT BOUND IN SPECIES	# 270	F-1
H3AsO4	2.8	PERCENT BOUND IN SPECIES	#3300611	H2AsO4 -
	97.2	PERCENT BOUND IN SPECIES	#3300612	HAsO4 -2
Zn+2	37.2	PERCENT BOUND IN SPECIES	# 950	Zn+2
	5.8	PERCENT BOUND IN SPECIES	#9503300	ZnOH +
	10.5	PERCENT BOUND IN SPECIES	#9503301	Zn(OH)2 AQ
	1.2	PERCENT BOUND IN SPECIES	#9507320	ZnSO4 AQ
	2.9	PERCENT BOUND IN SPECIES	#9501400	ZnHCO3 +
	36.3	PERCENT BOUND IN SPECIES	#9501401	ZnCO3 AQ
	6.1	PERCENT BOUND IN SPECIES	#9501402	Zn(CO3)2-2
H3BO3	90.7	PERCENT BOUND IN SPECIES	# 90	H3BO3
	9.3	PERCENT BOUND IN SPECIES	#3300900	H2BO3 -1
Pb+2	1.1	PERCENT BOUND IN SPECIES	# 600	Pb+2
	1.8	PERCENT BOUND IN SPECIES	#6001400	Pb(CO3)2-2
	3.0	PERCENT BOUND IN SPECIES	#6003300	PbOH +
	93.2	PERCENT BOUND IN SPECIES	#6001401	PbCO3 AQ
Mg+2	96.3	PERCENT BOUND IN SPECIES	# 460	Mg+2
	2.4	PERCENT BOUND IN SPECIES	#4607320	MgSO4 AQ
SeO4-2	100.0	PERCENT BOUND IN SPECIES	# 762	SeO4-2
Sr+2	100.0	PERCENT BOUND IN SPECIES	# 800	Sr+2
Mn+3	100.0	PERCENT BOUND IN SPECIES	# 471	Mn+3
Na+1	99.9	PERCENT BOUND IN SPECIES	# 500	Na+1
Ca+2	95.9	PERCENT BOUND IN SPECIES	# 150	Ca+2
	2.8	PERCENT BOUND IN SPECIES	#1507320	CaSO4 AQ
CO3-2	96.5	PERCENT BOUND IN SPECIES	#3301400	HCO3 -
	1.2	PERCENT BOUND IN SPECIES	#3301401	H2CO3 AQ
PO4-3	16.4	PERCENT BOUND IN SPECIES	#1505800	CaHPO4 AQ
	6.9	PERCENT BOUND IN SPECIES	#1505801	CaPO4 -
	69.7	PERCENT BOUND IN SPECIES	#3305800	HPO4 -2
	5.6	PERCENT BOUND IN SPECIES	#3305801	H2PO4 -
Al+3	94.7	PERCENT BOUND IN SPECIES	# 303302	Al(OH)4 -
	5.3	PERCENT BOUND IN SPECIES	# 303303	Al(OH)3 AQ
SO4-2	91.4	PERCENT BOUND IN SPECIES	# 732	SO4-2
	8.0	PERCENT BOUND IN SPECIES	#1507320	CaSO4 AQ
H2O	65.4	PERCENT BOUND IN SPECIES	#3300020	OH-
	1.9	PERCENT BOUND IN SPECIES	# 303302	Al(OH)4 -
	6.7	PERCENT BOUND IN SPECIES	#9503300	ZnOH +
	24.6	PERCENT BOUND IN SPECIES	#9503301	Zn(OH)2 AQ
Ba+2	100.0	PERCENT BOUND IN SPECIES	# 100	Ba+2

---------- EQUILIBRATED MASS DISTRIBUTION ----------

IDX	NAME	DISSOLVED		SORBED		PRECIPITATED	
		MOL/KG	PERCENT	MOL/KG	PERCENT	MOL/KG	PERCENT
330	H+1	8.553E-04	100.0	0.000E-01	0.0	0.000E-01	0.0
180	Cl-1	6.488E-05	100.0	0.000E-01	0.0	0.000E-01	0.0
270	F-1	8.479E-08	100.0	0.000E-01	0.0	0.000E-01	0.0
61	H3AsO4	6.022E-13	0.0	0.000E-01	0.0	1.252E-07	100.0
950	Zn+2	3.213E-06	100.0	0.000E-01	0.0	0.000E-01	0.0
90	H3BO3	1.850E-05	100.0	0.000E-01	0.0	0.000E-01	0.0
600	Pb+2	8.206E-08	100.0	0.000E-01	0.0	0.000E-01	0.0
460	Mg+2	2.819E-05	100.0	0.000E-01	0.0	0.000E-01	0.0
762	SeO4-2	4.897E-07	100.0	0.000E-01	0.0	0.000E-01	0.0
800	Sr+2	1.027E-06	100.0	0.000E-01	0.0	0.000E-01	0.0
471	Mn+3	1.758E-25	0.0	0.000E-01	0.0	1.638E-06	100.0
500	Na+1	9.120E-04	100.0	0.000E-01	0.0	0.000E-01	0.0
150	Ca+2	7.128E-04	100.0	0.000E-01	0.0	0.000E-01	0.0
140	CO3-2	8.636E-04	100.0	0.000E-01	0.0	0.000E-01	0.0
580	PO4-3	2.228E-08	100.0	0.000E-01	0.0	0.000E-01	0.0
30	Al+3	1.406E-08	0.3	0.000E-01	0.0	4.063E-06	99.7
732	SO4-2	2.490E-04	99.7	0.000E-01	0.0	8.190E-07	0.3
2	H2O	2.741E-06	100.0	0.000E-01	0.0	0.000E-01	0.0
100	Ba+2	7.408E-07	42.4	0.000E-01	0.0	1.007E-06	57.6

Charge Balance: SPECIATED

Sum of CATIONS = 2.343E-03 Sum of ANIONS 1.375E-03

PERCENT DIFFERENCE = 2.603E+01 (ANIONS - CATIONS)/(ANIONS + CATIONS)

EQUILIBRIUM IONIC STRENGTH (m) = 2.809E-03

EQUILIBRIUM pH = 8.226

DATE ID NUMBER: 960925
TIME ID NUMBER: 11122123

APPENDIX E

MODEL OUTPUT FOR EQUILIBRATION OF 1312 LEACHATE - SAMPLE W-2 BIOTITE GNEISS

```
EQUILIBRATION OF 1312 LEACHATE - SAMPLE W-2 BIOTITE GNEISS
pCO2=10E-3.5; INFINITE CALCITE, HEMATITE, APATITE

25.00 MG/L   0.000  0.00000E-01
1 0 1 2 3 0 0 0 1 2 0 0 0
0   0   0
    330  6.215E-06   -8.21 y                  /H+1
    180  8.000E-01   -4.29 y                  /Cl-1
    270  1.000E-01   -4.98 y                  /F-1
    580  5.000E-02   -6.68 y                  /PO4-3
     30  3.200E-01   -4.90 y                  /Al+3
    100  2.100E-01   -5.56 y                  /Ba+2
    150  1.180E+01   -3.46 y                  /Ca+2
    460  8.000E-01   -3.00 y                  /Mg+2
    500  6.000E+00   -3.46 y                  /Na+1
    800  3.500E-01   -5.62                    /Sr+2
    950  1.900E-01   -5.27 y                  /Zn+2
     90  7.436E-01   -4.64 y                  /H3BO3
    140  2.400E+01   -6.84 y                  /Total CO3-2 alkali
     61  3.790E-02   -6.87 y                  /H3AsO4
    600  5.000E-03   -7.09 y                  /Pb+2

  3   4
3301403    21.6600    -0.5300                /CO2 (g)
5015001     8.4750     2.5850                /CALCITE
7015003    44.1990     0.0000                /HYDRAPATITE
7015002   114.4000   -39.3900                /FCO3APATITE
  6   2
5015000     8.3600     2.6150                /ARAGONITE
5015002    17.0000     8.2900                /DOLOMITE
```

EQUILIBRATION OF 1312 LEACHATE - SAMPLE W-2 BIOTITE GNEISS
pCO2=10E-3.5; INFINITE CALCITE, HEMATITE, APATITE

Temperature (Celsius): 25.00
Units of concentration: MG/L
Ionic strength to be computed.
If specified, carbonate concentration represents total inorganic carbon.
Do not automatically terminate if charge imbalance exceeds 30%
Precipitation is allowed for all solids in the thermodynamic database and
the print option for solids is set to: 2
The maximum number of iterations is: 200
The method used to compute activity coefficients is: Davies equation
Abbreviated output file

330	6.215E-06	-8.21 y
180	8.000E-01	-4.29 y
270	1.000E-01	-4.98 y
580	5.000E-02	-6.68 y
30	3.200E-01	-4.90 y
100	2.100E-01	-5.56 y
150	1.180E+01	-3.46 y
460	8.000E-01	-3.00 y
500	6.000E+00	-3.46 y
800	3.500E-01	-5.62
950	1.900E-01	-5.27 y
90	7.436E-01	-4.64 y
61	3.790E-02	-6.87 y
600	5.000E-03	-7.09 y
281	1.500E-01	-5.57 y
471	4.000E-02	-6.14
140	4.080E+01	-5.89 y
360	4.000E-04	-9.00

H2O has been inserted as a COMPONENT

3	5	
3301403	21.6600	-0.5300
5015001	8.4750	2.5850
7015003	44.1990	0.0000
7015002	114.4000	-39.3900
3028100	4.0080	30.8450
6	2	
5015000	8.3600	2.6150
5015002	17.0000	8.2900

Charge Balance: UNSPECIATED

Sum of CATIONS= 9.784E-04 Sum of ANIONS = 1.389E-03

PERCENT DIFFERENCE = 1.735E+01 (ANIONS - CATIONS)/(ANIONS + CATIONS)

IMPROVED ACTIVITY GUESSES PRIOR TO FIRST ITERATION:

PO4-3	Log activity guess:	-10.46
Al+3	Log activity guess:	-14.79
H3AsO4	Log activity guess:	-14.01
Fe+3	Log activity guess:	-17.10
CO3-2	Log activity guess:	-5.24

PART 3 of OUTPUT FILE

PC MINTEQA2 v3.10 DATE OF CALCULATIONS: 24-SEP-96 TIME: 15:41:25

PARAMETERS OF THE COMPONENT MOST OUT OF BALANCE:

ITER	NAME	TOTAL MOL	DIFF FXN	LOG ACTVTY	RESIDUAL
0	H3BO3	1.203E-05	1.302E-05	-4.64000	1.301E-05
1	H3AsO4	2.670E-07	8.313E-07	-15.00769	8.312E-07
2	H3AsO4	2.670E-07	1.617E-06	-14.76362	1.617E-06
3	H3AsO4	2.670E-07	6.413E-07	-14.77605	6.412E-07
4	H3AsO4	2.670E-07	1.261E-07	-14.81173	1.260E-07
5	H3AsO4	2.670E-07	-4.323E-08	-14.82379	4.320E-08
6	H3AsO4	2.670E-07	-5.175E-08	-14.71047	5.173E-08
7	H3AsO4	2.670E-07	-3.320E-08	-14.59999	3.317E-08
8	H3AsO4	2.670E-07	-1.844E-08	-14.53249	1.841E-08
9	H3AsO4	2.670E-07	-9.093E-09	-14.49605	9.066E-09
10	H3AsO4	2.670E-07	-4.006E-09	-14.47837	3.979E-09
11	H3AsO4	2.670E-07	-1.552E-09	-14.47064	1.525E-09
12	H3AsO4	2.670E-07	-4.422E-10	-14.46766	4.154E-10
13	H3AsO4	2.670E-07	-5.665E-11	-14.46681	2.994E-11

ID	NAME	ANAL MOL	CALC MOL	LOG ACTVTY	GAMMA	DIFF FXN
330	H+1	6.166E-09	4.101E-09	-8.40561	0.958204	1.972E-09
180	Cl-1	2.257E-05	2.257E-05	-4.66508	0.958204	-5.764E-11
270	F-1	5.264E-06	1.413E-07	-6.86849	0.958204	4.577E-09
600	Pb+2	2.413E-08	1.083E-10	-10.03938	0.843010	-1.128E-14
30	Al+3	1.186E-05	3.836E-16	-15.58295	0.680963	-2.918E-11
100	Ba+2	1.529E-06	1.529E-06	-5.88973	0.843010	-1.562E-11
360	Hg2+2	9.971E-10	9.971E-10	-9.07542	0.843010	-1.019E-14
460	Mg+2	3.291E-05	3.185E-05	-4.57110	0.843010	-6.066E-11
471	Mn+3	7.281E-07	7.281E-07	-6.30467	0.680963	-1.674E-11
800	Sr+2	3.995E-06	3.995E-06	-5.47269	0.843010	-4.082E-11
950	Zn+2	2.907E-06	5.489E-07	-6.33467	0.843010	-1.086E-11
90	H3BO3	1.203E-05	1.043E-05	-4.98138	1.000333	-3.631E-12
61	H3AsO4	2.670E-07	3.413E-15	-14.46671	1.000333	-2.691E-12
580	PO4-3	5.265E-07	4.738E-12	-11.49129	0.680963	-2.711E-20
150	Ca+2	2.944E-04	2.806E-04	-3.62615	0.843010	0.000E-01
500	Na+1	2.610E-04	2.600E-04	-3.60353	0.958204	4.503E-23
281	Fe+3	2.686E-06	8.832E-28	-27.22083	0.680963	2.482E-23
140	CO3-2	6.799E-04	1.680E-05	-4.84878	0.843010	1.317E-22
2	H2O	0.000E-01	-6.554E-04	-0.00001	1.000000	-2.118E-22

PERCENTAGE DISTRIBUTION OF COMPONENTS AMONG
TYPE I and TYPE II (dissolved and adsorbed) species

H+1	102.3	PERCENT BOUND IN SPECIES #3301400	HCO3 -	
	1.7	PERCENT BOUND IN SPECIES #3301401	H2CO3 AQ	
Cl-1	100.0	PERCENT BOUND IN SPECIES # 180	Cl-1	
F-1	99.6	PERCENT BOUND IN SPECIES # 270	F-1	
Pb+2	3.9	PERCENT BOUND IN SPECIES #6001400	Pb(CO3)2-2	
	2.0	PERCENT BOUND IN SPECIES #6003300	PbOH +	
	93.1	PERCENT BOUND IN SPECIES #6001401	PbCO3 AQ	
Al+3	96.4	PERCENT BOUND IN SPECIES # 303302	Al(OH)4 -	
	3.6	PERCENT BOUND IN SPECIES # 303303	Al(OH)3 AQ	
Ba+2	100.0	PERCENT BOUND IN SPECIES # 100	Ba+2	
Hg2+2	100.0	PERCENT BOUND IN SPECIES # 360	Hg2+2	
Mg+2	97.7	PERCENT BOUND IN SPECIES # 460	Mg+2	
	1.1	PERCENT BOUND IN SPECIES #4601400	MgCO3 AQ	
	1.2	PERCENT BOUND IN SPECIES #4601401	MgHCO3 +	
Mn+3	100.0	PERCENT BOUND IN SPECIES # 471	Mn+3	
Sr+2	100.0	PERCENT BOUND IN SPECIES # 800	Sr+2	
Zn+2	18.9	PERCENT BOUND IN SPECIES # 950	Zn+2	
	4.6	PERCENT BOUND IN SPECIES #9503300	ZnOH +	
	13.0	PERCENT BOUND IN SPECIES #9503301	Zn(OH)2 AQ	
	2.3	PERCENT BOUND IN SPECIES #9501400	ZnHCO3 +	
	45.0	PERCENT BOUND IN SPECIES #9501401	ZnCO3 AQ	
	16.2	PERCENT BOUND IN SPECIES #9501402	Zn(CO3)2-2	
H3BO3	86.8	PERCENT BOUND IN SPECIES # 90	H3BO3	
	13.2	PERCENT BOUND IN SPECIES #3300900	H2BO3 -1	
H3AsO4	1.9	PERCENT BOUND IN SPECIES #3300611	H2AsO4 -	
	98.0	PERCENT BOUND IN SPECIES #3300612	HAsO4 -2	
PO4-3	1.3	PERCENT BOUND IN SPECIES #4605802	MgHPO4 AQ	
	8.7	PERCENT BOUND IN SPECIES #1505800	CaHPO4 AQ	
	5.4	PERCENT BOUND IN SPECIES #1505801	CaPO4 -	
	79.2	PERCENT BOUND IN SPECIES #3305800	HPO4 -2	
	4.4	PERCENT BOUND IN SPECIES #3305801	H2PO4 -	
Ca+2	97.3	PERCENT BOUND IN SPECIES # 150	Ca+2	
	1.1	PERCENT BOUND IN SPECIES #1501400	CaHCO3 +	
	1.7	PERCENT BOUND IN SPECIES #1501401	CaCO3 AQ	
Na+1	99.9	PERCENT BOUND IN SPECIES # 500	Na+1	
Fe+3	8.7	PERCENT BOUND IN SPECIES #2813301	FeOH2 +	
	25.0	PERCENT BOUND IN SPECIES #2813302	FeOH3 AQ	
	66.3	PERCENT BOUND IN SPECIES #2813303	FeOH4 -	
CO3-2	1.3	PERCENT BOUND IN SPECIES # 140	CO3-2	
	97.0	PERCENT BOUND IN SPECIES #3301400	HCO3 -	
H2O	5.3	PERCENT BOUND IN SPECIES #3300020	OH-	
	90.4	PERCENT BOUND IN SPECIES # 303302	Al(OH)4 -	
	2.6	PERCENT BOUND IN SPECIES # 303303	Al(OH)3 AQ	
	1.5	PERCENT BOUND IN SPECIES #9503301	Zn(OH)2 AQ	

---------- PROVISIONAL MASS DISTRIBUTION ----------

IDX	NAME	DISSOLVED		SORBED		PRECIPITATED	
		MOL/KG	PERCENT	MOL/KG	PERCENT	MOL/KG	PERCENT
330	H+1	1.213E-03	100.0	0.000E-01	0.0	0.000E-01	0.0
180	Cl-1	2.257E-05	100.0	0.000E-01	0.0	0.000E-01	0.0
270	F-1	1.418E-07	100.0	0.000E-01	0.0	0.000E-01	0.0
600	Pb+2	2.413E-08	100.0	0.000E-01	0.0	0.000E-01	0.0
30	Al+3	1.186E-05	100.0	0.000E-01	0.0	0.000E-01	0.0
100	Ba+2	1.529E-06	100.0	0.000E-01	0.0	0.000E-01	0.0
360	Hg2+2	9.971E-10	100.0	0.000E-01	0.0	0.000E-01	0.0
460	Mg+2	3.261E-05	100.0	0.000E-01	0.0	0.000E-01	0.0
471	Mn+3	7.281E-07	100.0	0.000E-01	0.0	0.000E-01	0.0
800	Sr+2	3.995E-06	100.0	0.000E-01	0.0	0.000E-01	0.0
950	Zn+2	2.907E-06	100.0	0.000E-01	0.0	0.000E-01	0.0
90	H3BO3	1.203E-05	100.0	0.000E-01	0.0	0.000E-01	0.0
61	H3AsO4	2.670E-07	100.0	0.000E-01	0.0	0.000E-01	0.0
580	PO4-3	4.211E-08	100.0	0.000E-01	0.0	0.000E-01	0.0
150	Ca+2	2.884E-04	100.0	0.000E-01	0.0	0.000E-01	0.0
500	Na+1	2.603E-04	100.0	0.000E-01	0.0	0.000E-01	0.0
281	Fe+3	9.966E-16	100.0	0.000E-01	0.0	0.000E-01	0.0
140	CO3-2	1.279E-03	100.0	0.000E-01	0.0	0.000E-01	0.0
2	H2O	5.060E-05	100.0	0.000E-01	0.0	0.000E-01	0.0

Charge Balance: SPECIATED

Sum of CATIONS = 9.028E-04 Sum of ANIONS 1.314E-03

PERCENT DIFFERENCE = 1.856E+01 (ANIONS - CATIONS)/(ANIONS + CATIONS)

PROVISIONAL IONIC STRENGTH (m) = 1.447E-03

PC MINTEQA2 v3.10 DATE OF CALCULATIONS: 24-SEP-96 TIME: 15:41:26

ITERATIONS= 15: SOLID BIXBYITE PRECIPITATES

PARAMETERS OF THE COMPONENT MOST OUT OF BALANCE:

ITER	NAME	TOTAL MOL	DIFF FXN	LOG ACTVTY	RESIDUAL
15	H3BO3	1.203E-05	-6.307E-08	-4.98138	6.187E-08
16	H3BO3	1.203E-05	6.033E-08	-4.97827	5.912E-08
17	H3BO3	1.203E-05	2.409E-09	-4.98121	1.207E-09
18	Sr+2	3.995E-06	7.609E-10	-5.47252	3.614E-10

ID	NAME	ANAL MOL	CALC MOL	LOG ACTVTY	GAMMA	DIFF FXN
330	H+1	6.166E-09	4.105E-09	-8.40522	0.958245	-1.385E-09
180	Cl-1	2.257E-05	2.257E-05	-4.66506	0.958245	3.961E-11
270	F-1	5.264E-06	1.411E-07	-6.86885	0.958245	-3.189E-09
600	Pb+2	2.413E-08	1.085E-10	-10.03857	0.843153	7.731E-15
30	Al+3	1.186E-05	3.849E-16	-15.58136	0.681223	1.999E-11
100	Ba+2	1.529E-06	1.529E-06	-5.88965	0.843153	1.074E-11
360	Hg2+2	9.971E-10	9.971E-10	-9.07534	0.843153	7.002E-15
460	Mg+2	3.291E-05	3.185E-05	-4.57101	0.843153	3.916E-11
61	H3AsO4	2.670E-07	3.420E-15	-14.46584	1.000333	1.848E-12
800	Sr+2	3.995E-06	3.995E-06	-5.47261	0.843153	2.805E-11
950	Zn+2	2.907E-06	5.498E-07	-6.33390	0.843153	7.454E-12
90	H3BO3	1.203E-05	1.044E-05	-4.98133	1.000333	2.493E-12
471	Mn+3	7.281E-07	4.421E-26	-25.52114	0.681223	-2.425E-20
580	PO4-3	5.265E-07	4.723E-12	-11.49248	0.681223	1.337E-20
500	Na+1	2.610E-04	2.600E-04	-3.60351	0.958245	-2.363E-23
150	Ca+2	2.944E-04	2.810E-04	-3.62536	0.843153	-8.470E-22
140	CO3-2	6.799E-04	1.677E-05	-4.84957	0.843153	1.079E-22
281	Fe+3	2.686E-06	8.853E-28	-27.21964	0.681223	0.000E-01
2	H2O	0.000E-01	-6.548E-04	-0.00001	1.000000	0.000E-01

PERCENTAGE DISTRIBUTION OF COMPONENTS AMONG
TYPE I and TYPE II (dissolved and adsorbed) species

H+1	102.3	PERCENT BOUND IN SPECIES	#3301400	HCO3 -
1.7	PERCENT BOUND IN SPECIES	#3301401	H2CO3 AQ	
Cl-1	100.0	PERCENT BOUND IN SPECIES	# 180	Cl-1
F-1	99.6	PERCENT BOUND IN SPECIES	# 270	F-1
Pb+2	3.9	PERCENT BOUND IN SPECIES	#6001400	Pb(CO3)2-2
2.0	PERCENT BOUND IN SPECIES	#6003300	PbOH +	
93.1	PERCENT BOUND IN SPECIES	#6001401	PbCO3 AQ	
Al+3	96.4	PERCENT BOUND IN SPECIES	# 303302	Al(OH)4 -
3.6	PERCENT BOUND IN SPECIES	# 303303	Al(OH)3 AQ	
Ba+2	100.0	PERCENT BOUND IN SPECIES	# 100	Ba+2
Hg2+2	100.0	PERCENT BOUND IN SPECIES	# 360	Hg2+2
Mg+2	97.7	PERCENT BOUND IN SPECIES	# 460	Mg+2
1.1	PERCENT BOUND IN SPECIES	#4601400	MgCO3 AQ	
1.2	PERCENT BOUND IN SPECIES	#4601401	MgHCO3 +	
H3AsO4	1.9	PERCENT BOUND IN SPECIES	#3300611	H2AsO4 -
98.0	PERCENT BOUND IN SPECIES	#3300612	HAsO4 -2	
Sr+2	100.0	PERCENT BOUND IN SPECIES	# 800	Sr+2
Zn+2	18.9	PERCENT BOUND IN SPECIES	# 950	Zn+2
4.6	PERCENT BOUND IN SPECIES	#9503300	ZnOH +	
13.0	PERCENT BOUND IN SPECIES	#9503301	Zn(OH)2 AQ	
2.3	PERCENT BOUND IN SPECIES	#9501400	ZnHCO3 +	
45.0	PERCENT BOUND IN SPECIES	#9501401	ZnCO3 AQ	
16.1	PERCENT BOUND IN SPECIES	#9501402	Zn(CO3)2-2	
H3BO3	86.8	PERCENT BOUND IN SPECIES	# 90	H3BO3
13.2	PERCENT BOUND IN SPECIES	#3300900	H2BO3 -1	
Mn+3	100.0	PERCENT BOUND IN SPECIES	# 471	Mn+3
PO4-3	1.3	PERCENT BOUND IN SPECIES	#4605802	MgHPO4 AQ
8.7	PERCENT BOUND IN SPECIES	#1505800	CaHPO4 AQ	
5.4	PERCENT BOUND IN SPECIES	#1505801	CaPO4 -	
79.2	PERCENT BOUND IN SPECIES	#3305800	HPO4 -2	
4.4	PERCENT BOUND IN SPECIES	#3305801	H2PO4 -	
Na+1	99.9	PERCENT BOUND IN SPECIES	# 500	Na+1
Ca+2	97.3	PERCENT BOUND IN SPECIES	# 150	Ca+2
1.1	PERCENT BOUND IN SPECIES	#1501400	CaHCO3 +	
1.6	PERCENT BOUND IN SPECIES	#1501401	CaCO3 AQ	
CO3-2	1.3	PERCENT BOUND IN SPECIES	# 140	CO3-2
97.0	PERCENT BOUND IN SPECIES	#3301400	HCO3 -	
Fe+3	8.7	PERCENT BOUND IN SPECIES	#2813301	FeOH2 +
25.0	PERCENT BOUND IN SPECIES	#2813302	FeOH3 AQ	
66.3	PERCENT BOUND IN SPECIES	#2813303	FeOH4 -	
H2O	5.3	PERCENT BOUND IN SPECIES	#3300020	OH-
90.4	PERCENT BOUND IN SPECIES	# 303302	Al(OH)4 -	
2.6	PERCENT BOUND IN SPECIES	# 303303	Al(OH)3 AQ	
1.5	PERCENT BOUND IN SPECIES	#9503301	Zn(OH)2 AQ	

---------- PROVISIONAL MASS DISTRIBUTION ----------

IDX	NAME	DISSOLVED		SORBED		PRECIPITATED	
		MOL/KG	PERCENT	MOL/KG	PERCENT	MOL/KG	PERCENT
330	H+1	1.212E-03	100.0	0.000E-01	0.0	0.000E-01	0.0
180	Cl-1	2.257E-05	100.0	0.000E-01	0.0	0.000E-01	0.0
270	F-1	1.417E-07	100.0	0.000E-01	0.0	0.000E-01	0.0
600	Pb+2	2.413E-08	100.0	0.000E-01	0.0	0.000E-01	0.0
30	Al+3	1.186E-05	100.0	0.000E-01	0.0	0.000E-01	0.0
100	Ba+2	1.529E-06	100.0	0.000E-01	0.0	0.000E-01	0.0
360	Hg2+2	9.971E-10	100.0	0.000E-01	0.0	0.000E-01	0.0
460	Mg+2	3.261E-05	100.0	0.000E-01	0.0	0.000E-01	0.0
61	H3AsO4	2.670E-07	100.0	0.000E-01	0.0	0.000E-01	0.0
800	Sr+2	3.995E-06	100.0	0.000E-01	0.0	0.000E-01	0.0
950	Zn+2	2.907E-06	100.0	0.000E-01	0.0	0.000E-01	0.0
90	H3BO3	1.203E-05	100.0	0.000E-01	0.0	0.000E-01	0.0
471	Mn+3	4.421E-26	0.0	0.000E-01	0.0	7.281E-07	100.0
580	PO4-3	4.203E-08	100.0	0.000E-01	0.0	0.000E-01	0.0
500	Na+1	2.603E-04	100.0	0.000E-01	0.0	0.000E-01	0.0
150	Ca+2	2.888E-04	100.0	0.000E-01	0.0	0.000E-01	0.0
140	CO3-2	1.278E-03	100.0	0.000E-01	0.0	0.000E-01	0.0
281	Fe+3	9.960E-16	100.0	0.000E-01	0.0	0.000E-01	0.0
2	H2O	5.059E-05	100.0	0.000E-01	0.0	0.000E-01	0.0

Charge Balance: SPECIATED

Sum of CATIONS = 9.016E-04 Sum of ANIONS 1.313E-03

PERCENT DIFFERENCE = 1.858E+01 (ANIONS - CATIONS)/(ANIONS + CATIONS)

PROVISIONAL IONIC STRENGTH (m) = 1.444E-03
PC MINTEQA2 v3.10 DATE OF CALCULATIONS: 24-SEP-96 TIME: 15:41:28

ITERATIONS= 19: SOLID BA(ASO4)2 PRECIPITATES

PARAMETERS OF THE COMPONENT MOST OUT OF BALANCE:

ITER	NAME	TOTAL MOL	DIFF FXN	LOG ACTVTY	RESIDUAL
19	Zn+2	2.907E-06	-1.677E-07	-6.33390	1.674E-07
20	Zn+2	2.907E-06	1.660E-07	-6.29724	1.657E-07
21	Zn+2	2.907E-06	2.470E-09	-6.33296	2.179E-09
22	Sr+2	3.995E-06	7.617E-10	-5.47249	3.622E-10

ID	NAME	ANAL MOL	CALC MOL	LOG ACTVTY	GAMMA	DIFF FXN
330	H+1	6.166E-09	4.105E-09	-8.40517	0.958263	-1.382E-09
180	Cl-1	2.257E-05	2.257E-05	-4.66505	0.958263	3.969E-11
270	F-1	5.264E-06	1.411E-07	-6.86890	0.958263	-3.195E-09
600	Pb+2	2.413E-08	1.085E-10	-10.03846	0.843217	7.744E-15
30	Al+3	1.186E-05	3.850E-16	-15.58115	0.681339	2.003E-11
100	Ba+2	1.529E-06	1.129E-06	-6.02152	0.843217	7.940E-12
360	Hg2+2	9.971E-10	9.971E-10	-9.07531	0.843217	7.015E-15
460	Mg+2	3.291E-05	3.185E-05	-4.57098	0.843217	3.924E-11
90	H3BO3	1.203E-05	1.044E-05	-4.98132	1.000332	2.498E-12
800	Sr+2	3.995E-06	3.995E-06	-5.47257	0.843217	2.810E-11
950	Zn+2	2.907E-06	5.499E-07	-6.33379	0.843217	7.468E-12
2	H2O	-1.127E-19	-6.546E-04	-0.00001	1.000000	0.000E-01
140	CO3-2	6.799E-04	1.676E-05	-4.84967	0.843217	0.000E-01
580	PO4-3	5.265E-07	4.721E-12	-11.49263	0.681339	-3.516E-23
500	Na+1	2.610E-04	2.600E-04	-3.60351	0.958263	-2.316E-23
150	Ca+2	2.944E-04	2.811E-04	-3.62525	0.843217	1.348E-21
281	Fe+3	2.686E-06	8.854E-28	-27.21949	0.681339	0.000E-01
471	Mn+3	7.281E-07	4.422E-26	-25.52099	0.681339	0.000E-01
61	H3AsO4	2.670E-07	2.299E-21	-20.63823	1.000332	0.000E-01

PERCENTAGE DISTRIBUTION OF COMPONENTS AMONG
TYPE I and TYPE II (dissolved and adsorbed) species

H+1		102.3	PERCENT BOUND IN SPECIES #3301400	HCO3 -
	1.7	PERCENT BOUND IN SPECIES #3301401	H2CO3 AQ		
Cl-1		100.0	PERCENT BOUND IN SPECIES # 180	Cl-1
F-1		99.6	PERCENT BOUND IN SPECIES # 270	F-1
Pb+2		3.9	PERCENT BOUND IN SPECIES #6001400	Pb(CO3)2-2
	2.0	PERCENT BOUND IN SPECIES #6003300	PbOH +	
	93.1	PERCENT BOUND IN SPECIES #6001401	PbCO3 AQ	
Al+3		96.4	PERCENT BOUND IN SPECIES # 303302	Al(OH)4 -
	3.6	PERCENT BOUND IN SPECIES # 303303	Al(OH)3 AQ	
Ba+2		100.0	PERCENT BOUND IN SPECIES # 100	Ba+2
Hg2+2		100.0	PERCENT BOUND IN SPECIES # 360	Hg2+2
Mg+2		97.7	PERCENT BOUND IN SPECIES # 460	Mg+2
	1.1	PERCENT BOUND IN SPECIES #4601400	MgCO3 AQ	
	1.2	PERCENT BOUND IN SPECIES #4601401	MgHCO3 +	
H3BO3		86.8	PERCENT BOUND IN SPECIES # 90	H3BO3
	13.2	PERCENT BOUND IN SPECIES #3300900	H2BO3 -1	
Sr+2		100.0	PERCENT BOUND IN SPECIES # 800	Sr+2
Zn+2		18.9	PERCENT BOUND IN SPECIES # 950	Zn+2
	4.6	PERCENT BOUND IN SPECIES #9503300	ZnOH +	
	13.0	PERCENT BOUND IN SPECIES #9503301	Zn(OH)2 AQ	
	2.3	PERCENT BOUND IN SPECIES #9501400	ZnHCO3 +	
	45.0	PERCENT BOUND IN SPECIES #9501401	ZnCO3 AQ	
	16.1	PERCENT BOUND IN SPECIES #9501402	Zn(CO3)2-2	
H2O		5.3	PERCENT BOUND IN SPECIES #3300020	OH-
	90.4	PERCENT BOUND IN SPECIES # 303302	Al(OH)4 -	
	2.6	PERCENT BOUND IN SPECIES # 303303	Al(OH)3 AQ	
	1.5	PERCENT BOUND IN SPECIES #9503301	Zn(OH)2 AQ	
CO3-2		1.3	PERCENT BOUND IN SPECIES # 140	CO3-2
	97.0	PERCENT BOUND IN SPECIES #3301400	HCO3 -	
PO4-3		1.3	PERCENT BOUND IN SPECIES #4605802	MgHPO4 AQ
	8.7	PERCENT BOUND IN SPECIES #1505800	CaHPO4 AQ	
	5.4	PERCENT BOUND IN SPECIES #1505801	CaPO4 -	
	79.2	PERCENT BOUND IN SPECIES #3305800	HPO4 -2	
	4.4	PERCENT BOUND IN SPECIES #3305801	H2PO4 -	
Na+1		99.9	PERCENT BOUND IN SPECIES # 500	Na+1
Ca+2		97.3	PERCENT BOUND IN SPECIES # 150	Ca+2
	1.1	PERCENT BOUND IN SPECIES #1501400	CaHCO3 +	
	1.6	PERCENT BOUND IN SPECIES #1501401	CaCO3 AQ	
Fe+3		8.7	PERCENT BOUND IN SPECIES #2813301	FeOH2 +
	25.0	PERCENT BOUND IN SPECIES #2813302	FeOH3 AQ	
	66.3	PERCENT BOUND IN SPECIES #2813303	FeOH4 -	
Mn+3		100.0	PERCENT BOUND IN SPECIES # 471	Mn+3
H3AsO4		1.9	PERCENT BOUND IN SPECIES #3300611	H2AsO4 -
	98.0	PERCENT BOUND IN SPECIES #3300612	HAsO4 -2	

---------- PROVISIONAL MASS DISTRIBUTION ----------

IDX	NAME	DISSOLVED MOL/KG	DISSOLVED PERCENT	SORBED MOL/KG	SORBED PERCENT	PRECIPITATED MOL/KG	PRECIPITATED PERCENT
330	H+1	1.212E-03	100.0	0.000E-01	0.0	0.000E-01	0.0
180	Cl-1	2.257E-05	100.0	0.000E-01	0.0	0.000E-01	0.0
270	F-1	1.417E-07	100.0	0.000E-01	0.0	0.000E-01	0.0
600	Pb+2	2.413E-08	100.0	0.000E-01	0.0	0.000E-01	0.0
30	Al+3	1.186E-05	100.0	0.000E-01	0.0	0.000E-01	0.0
100	Ba+2	1.129E-06	73.8	0.000E-01	0.0	4.005E-07	26.2
360	Hg2+2	9.971E-10	100.0	0.000E-01	0.0	0.000E-01	0.0
460	Mg+2	3.261E-05	100.0	0.000E-01	0.0	0.000E-01	0.0
90	H3BO3	1.203E-05	100.0	0.000E-01	0.0	0.000E-01	0.0
800	Sr+2	3.995E-06	100.0	0.000E-01	0.0	0.000E-01	0.0
950	Zn+2	2.907E-06	100.0	0.000E-01	0.0	0.000E-01	0.0
2	H2O	5.059E-05	100.0	0.000E-01	0.0	0.000E-01	0.0
140	CO3-2	1.278E-03	100.0	0.000E-01	0.0	0.000E-01	0.0
580	PO4-3	4.202E-08	100.0	0.000E-01	0.0	0.000E-01	0.0
500	Na+1	2.603E-04	100.0	0.000E-01	0.0	0.000E-01	0.0
150	Ca+2	2.889E-04	100.0	0.000E-01	0.0	0.000E-01	0.0
281	Fe+3	9.959E-16	100.0	0.000E-01	0.0	0.000E-01	0.0
471	Mn+3	4.422E-26	0.0	0.000E-01	0.0	7.281E-07	100.0
61	H3AsO4	1.795E-13	0.0	0.000E-01	0.0	2.670E-07	100.0

Charge Balance: SPECIATED

Sum of CATIONS = 9.009E-04 Sum of ANIONS 1.312E-03

PERCENT DIFFERENCE = 1.860E+01 (ANIONS - CATIONS)/(ANIONS + CATIONS)

PROVISIONAL IONIC STRENGTH (m) = 1.443E-03

PC MINTEQA2 v3.10 DATE OF CALCULATIONS: 24-SEP-96 TIME: 15:41:29

ITERATIONS= 23: SOLID Hg2(OH)2 PRECIPITATES

PARAMETERS OF THE COMPONENT MOST OUT OF BALANCE:

ITER	NAME	TOTAL MOL	DIFF FXN	LOG ACTVTY	RESIDUAL
23	Sr+2	3.995E-06	-6.263E-07	-5.47257	6.259E-07
24	Sr+2	3.995E-06	7.117E-07	-5.39852	7.113E-07
25	Sr+2	3.995E-06	2.554E-08	-5.46972	2.514E-08
26	Sr+2	3.995E-06	7.618E-10	-5.47249	3.623E-10

ID	NAME	ANAL MOL	CALC MOL	LOG ACTVTY	GAMMA	DIFF FXN
330	H+1	6.166E-09	4.105E-09	-8.40517	0.958263	-1.383E-09
180	Cl-1	2.257E-05	2.257E-05	-4.66505	0.958263	3.970E-11
270	F-1	5.264E-06	1.411E-07	-6.86890	0.958263	-3.195E-09
600	Pb+2	2.413E-08	1.085E-10	-10.03846	0.843217	7.746E-15
30	Al+3	1.186E-05	3.850E-16	-15.58115	0.681339	2.004E-11
100	Ba+2	1.529E-06	1.129E-06	-6.02152	0.843217	7.941E-12
950	Zn+2	2.907E-06	5.499E-07	-6.33379	0.843217	7.469E-12
460	Mg+2	3.291E-05	3.185E-05	-4.57098	0.843217	3.925E-11
90	H3BO3	1.203E-05	1.044E-05	-4.98132	1.000332	2.498E-12
800	Sr+2	3.995E-06	3.995E-06	-5.47257	0.843217	2.811E-11
360	Hg2+2	9.971E-10	3.342E-12	-11.55001	0.843217	0.000E-01
150	Ca+2	2.944E-04	2.811E-04	-3.62525	0.843217	1.631E-20
140	CO3-2	6.799E-04	1.676E-05	-4.84968	0.843217	0.000E-01
580	PO4-3	5.265E-07	4.721E-12	-11.49263	0.681339	4.235E-22
500	Na+1	2.610E-04	2.600E-04	-3.60350	0.958263	-5.206E-23
281	Fe+3	2.686E-06	8.854E-28	-27.21949	0.681339	0.000E-01
471	Mn+3	7.281E-07	4.422E-26	-25.52099	0.681339	0.000E-01
61	H3AsO4	2.670E-07	2.299E-21	-20.63822	1.000332	0.000E-01
2	H2O	-1.127E-19	-6.546E-04	-0.00001	1.000000	0.000E-01

PERCENTAGE DISTRIBUTION OF COMPONENTS AMONG
TYPE I and TYPE II (dissolved and adsorbed) species

H+1	102.3	PERCENT BOUND IN SPECIES #3301400	HCO3 -	
	1.7	PERCENT BOUND IN SPECIES #3301401	H2CO3 AQ	
Cl-1	100.0	PERCENT BOUND IN SPECIES # 180	Cl-1	
F-1	99.6	PERCENT BOUND IN SPECIES # 270	F-1	
Pb+2	3.9	PERCENT BOUND IN SPECIES #6001400	Pb(CO3)2-2	
	2.0	PERCENT BOUND IN SPECIES #6003300	PbOH +	
	93.1	PERCENT BOUND IN SPECIES #6001401	PbCO3 AQ	
Al+3	96.4	PERCENT BOUND IN SPECIES # 303302	Al(OH)4 -	
	3.6	PERCENT BOUND IN SPECIES # 303303	Al(OH)3 AQ	
Ba+2	100.0	PERCENT BOUND IN SPECIES # 100	Ba+2	
Zn+2	18.9	PERCENT BOUND IN SPECIES # 950	Zn+2	
	4.6	PERCENT BOUND IN SPECIES #9503300	ZnOH +	
	13.0	PERCENT BOUND IN SPECIES #9503301	Zn(OH)2 AQ	
	2.3	PERCENT BOUND IN SPECIES #9501400	ZnHCO3 +	
	45.0	PERCENT BOUND IN SPECIES #9501401	ZnCO3 AQ	
	16.1	PERCENT BOUND IN SPECIES #9501402	Zn(CO3)2-2	
Mg+2	97.7	PERCENT BOUND IN SPECIES # 460	Mg+2	
	1.1	PERCENT BOUND IN SPECIES #4601400	MgCO3 AQ	
	1.2	PERCENT BOUND IN SPECIES #4601401	MgHCO3 +	
H3BO3	86.8	PERCENT BOUND IN SPECIES # 90	H3BO3	
	13.2	PERCENT BOUND IN SPECIES #3300900	H2BO3 -1	
Sr+2	100.0	PERCENT BOUND IN SPECIES # 800	Sr+2	
Hg2+2	100.0	PERCENT BOUND IN SPECIES # 360	Hg2+2	
Ca+2	97.3	PERCENT BOUND IN SPECIES # 150	Ca+2	
	1.1	PERCENT BOUND IN SPECIES #1501400	CaHCO3 +	
	1.6	PERCENT BOUND IN SPECIES #1501401	CaCO3 AQ	
CO3-2	1.3	PERCENT BOUND IN SPECIES # 140	CO3-2	
	97.0	PERCENT BOUND IN SPECIES #3301400	HCO3 -	
PO4-3	1.3	PERCENT BOUND IN SPECIES #4605802	MgHPO4 AQ	
	8.7	PERCENT BOUND IN SPECIES #1505800	CaHPO4 AQ	
	5.4	PERCENT BOUND IN SPECIES #1505801	CaPO4 -	
	79.2	PERCENT BOUND IN SPECIES #3305800	HPO4 -2	
	4.4	PERCENT BOUND IN SPECIES #3305801	H2PO4 -	
Na+1	99.9	PERCENT BOUND IN SPECIES # 500	Na+1	
Fe+3	8.7	PERCENT BOUND IN SPECIES #2813301	FeOH2 +	
	25.0	PERCENT BOUND IN SPECIES #2813302	FeOH3 AQ	
	66.3	PERCENT BOUND IN SPECIES #2813303	FeOH4 -	
Mn+3	100.0	PERCENT BOUND IN SPECIES # 471	Mn+3	
H3AsO4	1.9	PERCENT BOUND IN SPECIES #3300611	H2AsO4 -	
	98.0	PERCENT BOUND IN SPECIES #3300612	HAsO4 -2	
H2O	5.3	PERCENT BOUND IN SPECIES #3300020	OH-	
	90.4	PERCENT BOUND IN SPECIES # 303302	Al(OH)4 -	
	2.6	PERCENT BOUND IN SPECIES # 303303	Al(OH)3 AQ	
	1.5	PERCENT BOUND IN SPECIES #9503301	Zn(OH)2 AQ	

PART 5 of OUTPUT FILE

PC MINTEQA2 v3.10 DATE OF CALCULATIONS: 24-SEP-96 TIME: 15:41:30

---------- PROVISIONAL MASS DISTRIBUTION ----------

IDX	NAME	DISSOLVED		SORBED		PRECIPITATED	
		MOL/KG	PERCENT	MOL/KG	PERCENT	MOL/KG	PERCENT
330	H+1	1.212E-03	100.0	0.000E-01	0.0	0.000E-01	0.0
180	Cl-1	2.257E-05	100.0	0.000E-01	0.0	0.000E-01	0.0
270	F-1	1.417E-07	100.0	0.000E-01	0.0	0.000E-01	0.0
600	Pb+2	2.413E-08	100.0	0.000E-01	0.0	0.000E-01	0.0
30	Al+3	1.186E-05	100.0	0.000E-01	0.0	0.000E-01	0.0
100	Ba+2	1.129E-06	73.8	0.000E-01	0.0	4.005E-07	26.2
950	Zn+2	2.907E-06	100.0	0.000E-01	0.0	0.000E-01	0.0
460	Mg+2	3.261E-05	100.0	0.000E-01	0.0	0.000E-01	0.0
90	H3BO3	1.203E-05	100.0	0.000E-01	0.0	0.000E-01	0.0
800	Sr+2	3.995E-06	100.0	0.000E-01	0.0	0.000E-01	0.0
360	Hg2+2	3.342E-12	0.3	0.000E-01	0.0	9.938E-10	99.7
150	Ca+2	2.889E-04	100.0	0.000E-01	0.0	0.000E-01	0.0
140	CO3-2	1.278E-03	100.0	0.000E-01	0.0	0.000E-01	0.0
580	PO4-3	4.202E-08	100.0	0.000E-01	0.0	0.000E-01	0.0
500	Na+1	2.603E-04	100.0	0.000E-01	0.0	0.000E-01	0.0
281	Fe+3	9.959E-16	100.0	0.000E-01	0.0	0.000E-01	0.0
471	Mn+3	4.422E-26	0.0	0.000E-01	0.0	7.281E-07	100.0
61	H3AsO4	1.795E-13	0.0	0.000E-01	0.0	2.670E-07	100.0
2	H2O	5.059E-05	100.0	0.000E-01	0.0	0.000E-01	0.0

Charge Balance: SPECIATED

Sum of CATIONS = 9.009E-04 Sum of ANIONS 1.312E-03

PERCENT DIFFERENCE = 1.860E+01 (ANIONS - CATIONS)/(ANIONS + CATIONS)

PROVISIONAL IONIC STRENGTH (m) = 1.443E-03

PC MINTEQA2 v3.10 DATE OF CALCULATIONS: 24-SEP-96 TIME: 15:41:30

ITERATIONS= 27: SOLID DIASPORE PRECIPITATES

PART 3 of OUTPUT FILE

PC MINTEQA2 v3.10 DATE OF CALCULATIONS: 24-SEP-96 TIME: 15:41:30

PARAMETERS OF THE COMPONENT MOST OUT OF BALANCE:

ITER	NAME	TOTAL MOL	DIFF FXN	LOG ACTVTY	RESIDUAL
27	H3BO3	1.203E-05	-6.292E-08	-4.98132	6.171E-08
28	H3BO3	1.203E-05	6.027E-08	-4.97854	5.907E-08
29	H3BO3	1.203E-05	2.405E-09	-4.98146	1.203E-09
30	Ba+2	1.129E-06	2.153E-10	-6.02124	1.024E-10

ID	NAME	ANAL MOL	CALC MOL	LOG ACTVTY	GAMMA	DIFF FXN
330	H+1	6.166E-09	4.086E-09	-8.40718	0.958372	-1.357E-09
180	Cl-1	2.257E-05	2.257E-05	-4.66500	0.958372	3.986E-11
270	F-1	5.264E-06	1.417E-07	-6.86714	0.958372	-3.206E-09
600	Pb+2	2.413E-08	1.075E-10	-10.04257	0.843600	7.825E-15
800	Sr+2	3.995E-06	3.995E-06	-5.47237	0.843600	2.822E-11
100	Ba+2	1.529E-06	1.129E-06	-6.02132	0.843600	7.973E-12
950	Zn+2	2.907E-06	5.450E-07	-6.33750	0.843600	7.495E-12
460	Mg+2	3.291E-05	3.184E-05	-4.57085	0.843600	3.947E-11
90	H3BO3	1.203E-05	1.043E-05	-4.98158	1.000330	2.520E-12
30	Al+3	1.186E-05	6.572E-19	-18.34851	0.682036	0.000E-01
500	Na+1	2.610E-04	2.600E-04	-3.60345	0.958372	-4.855E-20
150	Ca+2	2.944E-04	2.783E-04	-3.62927	0.843600	-3.929E-23
140	CO3-2	6.799E-04	1.691E-05	-4.84566	0.843600	0.000E-01
580	PO4-3	5.265E-07	4.782E-12	-11.48660	0.682036	-7.329E-22
281	Fe+3	2.686E-06	8.723E-28	-27.22552	0.682036	0.000E-01
471	Mn+3	7.281E-07	4.357E-26	-25.52702	0.682036	0.000E-01
61	H3AsO4	2.670E-07	2.266E-21	-20.64455	1.000330	0.000E-01
360	Hg2+2	9.971E-10	3.310E-12	-11.55404	0.843600	0.000E-01
2	H2O	-1.127E-19	-6.399E-04	-0.00001	1.000000	0.000E-01

PERCENTAGE DISTRIBUTION OF COMPONENTS AMONG
TYPE I and TYPE II (dissolved and adsorbed) species

H+1	98.5	PERCENT BOUND IN SPECIES	#3301400	HCO3 -
1.7	PERCENT BOUND IN SPECIES	#3301401	H2CO3 AQ	
Cl-1	100.0	PERCENT BOUND IN SPECIES	# 180	Cl-1
F-1	99.6	PERCENT BOUND IN SPECIES	# 270	F-1
Pb+2	4.0	PERCENT BOUND IN SPECIES	#6001400	Pb(CO3)2-2
2.0	PERCENT BOUND IN SPECIES	#6003300	PbOH +	
93.1	PERCENT BOUND IN SPECIES	#6001401	PbCO3 AQ	
Sr+2	100.0	PERCENT BOUND IN SPECIES	# 800	Sr+2
Ba+2	100.0	PERCENT BOUND IN SPECIES	# 100	Ba+2
Zn+2	18.7	PERCENT BOUND IN SPECIES	# 950	Zn+2
4.6	PERCENT BOUND IN SPECIES	#9503300	ZnOH +	
13.0	PERCENT BOUND IN SPECIES	#9503301	Zn(OH)2 AQ	
2.3	PERCENT BOUND IN SPECIES	#9501400	ZnHCO3 +	
45.0	PERCENT BOUND IN SPECIES	#9501401	ZnCO3 AQ	
16.3	PERCENT BOUND IN SPECIES	#9501402	Zn(CO3)2-2	
Mg+2	97.6	PERCENT BOUND IN SPECIES	# 460	Mg+2
1.1	PERCENT BOUND IN SPECIES	#4601400	MgCO3 AQ	
1.2	PERCENT BOUND IN SPECIES	#4601401	MgHCO3 +	
H3BO3	86.7	PERCENT BOUND IN SPECIES	# 90	H3BO3
13.3	PERCENT BOUND IN SPECIES	#3300900	H2BO3 -1	
Al+3	96.4	PERCENT BOUND IN SPECIES	# 303302	Al(OH)4 -
3.6	PERCENT BOUND IN SPECIES	# 303303	Al(OH)3 AQ	
Na+1	99.9	PERCENT BOUND IN SPECIES	# 500	Na+1
Ca+2	97.3	PERCENT BOUND IN SPECIES	# 150	Ca+2
1.1	PERCENT BOUND IN SPECIES	#1501400	CaHCO3 +	
1.7	PERCENT BOUND IN SPECIES	#1501401	CaCO3 AQ	
CO3-2	1.3	PERCENT BOUND IN SPECIES	# 140	CO3-2
97.0	PERCENT BOUND IN SPECIES	#3301400	HCO3 -	
PO4-3	1.3	PERCENT BOUND IN SPECIES	#4605802	MgHPO4 AQ
8.6	PERCENT BOUND IN SPECIES	#1505800	CaHPO4 AQ	
5.4	PERCENT BOUND IN SPECIES	#1505801	CaPO4 -	
79.3	PERCENT BOUND IN SPECIES	#3305800	HPO4 -2	
4.4	PERCENT BOUND IN SPECIES	#3305801	H2PO4 -	
Fe+3	8.7	PERCENT BOUND IN SPECIES	#2813301	FeOH2 +
24.9	PERCENT BOUND IN SPECIES	#2813302	FeOH3 AQ	
66.4	PERCENT BOUND IN SPECIES	#2813303	FeOH4 -	
Mn+3	100.0	PERCENT BOUND IN SPECIES	# 471	Mn+3
H3AsO4	1.9	PERCENT BOUND IN SPECIES	#3300611	H2AsO4 -
98.0	PERCENT BOUND IN SPECIES	#3300612	HAsO4 -2	
Hg2+2	100.0	PERCENT BOUND IN SPECIES	# 360	Hg2+2
H2O	72.8	PERCENT BOUND IN SPECIES	#3300020	OH-
2.2	PERCENT BOUND IN SPECIES	# 303302	Al(OH)4 -	
3.7	PERCENT BOUND IN SPECIES	#9503300	ZnOH +	
20.6	PERCENT BOUND IN SPECIES	#9503301	Zn(OH)2 AQ	

---------- EQUILIBRATED MASS DISTRIBUTION ----------

IDX	NAME	DISSOLVED		SORBED		PRECIPITATED	
		MOL/KG	PERCENT	MOL/KG	PERCENT	MOL/KG	PERCENT
330	H+1	1.264E-03	100.0	0.000E-01	0.0	0.000E-01	0.0
180	Cl-1	2.257E-05	100.0	0.000E-01	0.0	0.000E-01	0.0
270	F-1	1.422E-07	100.0	0.000E-01	0.0	0.000E-01	0.0
600	Pb+2	2.413E-08	100.0	0.000E-01	0.0	0.000E-01	0.0
800	Sr+2	3.995E-06	100.0	0.000E-01	0.0	0.000E-01	0.0
100	Ba+2	1.129E-06	73.8	0.000E-01	0.0	4.005E-07	26.2
950	Zn+2	2.907E-06	100.0	0.000E-01	0.0	0.000E-01	0.0
460	Mg+2	3.261E-05	100.0	0.000E-01	0.0	0.000E-01	0.0
90	H3BO3	1.203E-05	100.0	0.000E-01	0.0	0.000E-01	0.0
30	Al+3	2.064E-08	0.2	0.000E-01	0.0	1.184E-05	99.8
500	Na+1	2.603E-04	100.0	0.000E-01	0.0	0.000E-01	0.0
150	Ca+2	2.862E-04	100.0	0.000E-01	0.0	0.000E-01	0.0
140	CO3-2	1.284E-03	100.0	0.000E-01	0.0	0.000E-01	0.0
580	PO4-3	4.235E-08	100.0	0.000E-01	0.0	0.000E-01	0.0
281	Fe+3	9.985E-16	100.0	0.000E-01	0.0	0.000E-01	0.0
471	Mn+3	4.357E-26	0.0	0.000E-01	0.0	7.281E-07	100.0
61	H3AsO4	1.784E-13	0.0	0.000E-01	0.0	2.670E-07	100.0
360	Hg2+2	3.310E-12	0.3	0.000E-01	0.0	9.938E-10	99.7
2	H2O	3.679E-06	100.0	0.000E-01	0.0	0.000E-01	0.0

Charge Balance: SPECIATED

Sum of CATIONS = 8.954E-04 Sum of ANIONS 1.307E-03

PERCENT DIFFERENCE = 1.869E+01 (ANIONS - CATIONS)/(ANIONS + CATIONS)

EQUILIBRIUM IONIC STRENGTH (m) = 1.434E-03

EQUILIBRIUM pH = 8.407

DATE ID NUMBER: 960924
TIME ID NUMBER: 15413141

APPENDIX F

MODEL OUTPUT FOR EQUILIBRATION OF 1320 LEACHATE - SAMPLE E-1 SERICITE GNEISS

```
EQUILIBRATION OF 1320 LEACHATE - EXTRACTION 1 - SAMPLE E-1 SERICITE GNEISS
pCO2=10E-3.5; INFINITE CALCITE; EXCLUDE ARAGONITE, DOLOMITE

25.00 MG/L   0.000  0.00000E-01
0 0 1 2 3 0 0 0 1 2 0 0 0
0   0   0
    330  5.720E+00   -5.45 y                  /H+1
    140  1.248E+03   -3.00 y                  /TOTAL CARBON, CO3
    180  3.400E+00   -4.02 y                  /Cl-1
    270  1.000E-01   -5.28 y                  /F-1
    492  1.900E+00   -4.51 y                  /NO3-1
    732  4.000E+01   -3.38 y                  /SO4-2
     30  1.100E-01   -5.39 y                  /Al+3
    150  6.890E+02   -1.76 y                  /Ca+2
    212  3.000E-02   -6.59 y                  /CrO4-2
    231  1.300E-01   -5.69 y                  /Cu+2
    600  4.000E-03   -7.71 y                  /Pb+2
    460  4.900E+00   -3.70 y                  /Mg+2
    471  7.370E+00   -3.87 y                  /Mn+3
    410  2.200E+01   -3.25 y                  /K+1
    500  1.000E+01   -3.36 y                  /Na+1
    800  1.500E+00   -4.77 y                  /Sr+2
    950  1.300E+00   -4.70 y                  /Zn+2

  3   2
5015001     8.4750     2.5850                /CALCITE
3301403    21.6600    -0.5300                /CO2 (g)
  6   2
5015000     8.3600     2.6150                /ARAGONITE
5015002    17.0000     8.2900                /DOLOMITE
```

EQUILIBRATION OF 1320 LEACHATE - EXTRACTION 1 - SAMPLE E-1 SERICITE GNEISS
pCO2=10E-3.5; INFINITE CALCITE; EXCLUDE ARAGONITE, DOLOMITE

Temperature (Celsius): 25.00
Units of concentration: MG/L
Ionic strength to be computed.
If specified, carbonate concentration represents total inorganic carbon.
Do not automatically terminate if charge imbalance exceeds 30%
Precipitation is allowed for all solids in the thermodynamic database and
the print option for solids is set to: 2
The maximum number of iterations is: 200
The method used to compute activity coefficients is: Davies equation
Abbreviated output file

330	5.720E+00	-5.45 y
140	1.248E+03	-3.00 y
180	3.400E+00	-4.02 y
270	1.000E-01	-5.28 y
492	1.900E+00	-4.51 y
732	4.000E+01	-3.38 y
30	1.100E-01	-5.39 y
150	6.890E+02	-1.76 y
212	3.000E-02	-6.59 y
231	1.300E-01	-5.69 y
600	4.000E-03	-7.71 y
460	4.900E+00	-3.70 y
471	7.370E+00	-3.87 y
410	2.200E+01	-3.25 y
500	1.000E+01	-3.36 y
800	1.500E+00	-4.77 y
950	1.300E+00	-4.70 y

H2O has been inserted as a COMPONENT

3	2	
5015001	8.4750	2.5850
3301403	21.6600	-0.5300
6	2	
5015000	8.3600	2.6150
5015002	17.0000	8.2900

Charge Balance: UNSPECIATED

Sum of CATIONS= 4.203E-02 Sum of ANIONS = 4.265E-02

PERCENT DIFFERENCE = 7.209E-01 (ANIONS - CATIONS)/(ANIONS + CATIONS)

IMPROVED ACTIVITY GUESSES PRIOR TO FIRST ITERATION:

CO3-2	Log activity guess:	-10.76
SO4-2	Log activity guess:	-3.38
Al+3	Log activity guess:	-6.49
CrO4-2	Log activity guess:	-10.24
Cu+2	Log activity guess:	-5.69

PARAMETERS OF THE COMPONENT MOST OUT OF BALANCE:

ITER	NAME	TOTAL MOL	DIFF FXN	LOG ACTVTY	RESIDUAL
0	Na+1	4.359E-04	1.566E-06	-3.36000	1.523E-06
1	Pb+2	1.935E-08	4.503E-11	-7.81057	4.310E-11
2	Na+1	4.359E-04	1.172E-04	-3.36156	1.172E-04
3	Cu+2	2.050E-06	5.883E-09	-6.13764	5.678E-09
4	Na+1	4.359E-04	-1.872E-04	-3.46501	1.872E-04
5	Na+1	4.359E-04	3.432E-04	-3.22127	3.431E-04
6	Na+1	4.359E-04	3.037E-05	-3.47343	3.033E-05
7	Na+1	4.359E-04	-3.317E-05	-3.50250	3.312E-05
8	Na+1	4.359E-04	-4.562E-05	-3.46797	4.558E-05
9	Na+1	4.359E-04	-2.472E-05	-3.42002	2.468E-05
10	Na+1	4.359E-04	-3.166E-06	-3.39491	3.123E-06
11	Na+1	4.359E-04	-9.494E-07	-3.39172	9.058E-07
12	Na+1	4.359E-04	-1.482E-07	-3.39078	1.046E-07

ID	NAME	ANAL MOL	CALC MOL	LOG ACTVTY	GAMMA	DIFF FXN
330	H+1	5.686E-03	3.068E-09	-8.54187	0.935992	1.555E-10
800	Sr+2	1.715E-05	1.715E-05	-4.88055	0.767517	-1.309E-11
180	Cl-1	9.610E-05	9.610E-05	-4.04603	0.935992	-1.833E-11
270	F-1	5.274E-06	5.219E-06	-5.31118	0.935992	-1.006E-12
492	NO3-1	3.071E-05	3.071E-05	-4.54152	0.935992	-5.856E-12
732	SO4-2	4.172E-04	3.995E-04	-3.51336	0.767517	-3.051E-10
30	Al+3	4.085E-06	4.606E-17	-16.59518	0.551376	-7.576E-13
950	Zn+2	1.993E-05	2.043E-06	-5.80460	0.767517	-6.357E-12
212	CrO4-2	2.592E-07	2.561E-07	-6.70651	0.767517	-1.960E-13
231	Cu+2	2.050E-06	9.959E-10	-9.11670	0.767517	5.677E-15
600	Pb+2	1.935E-08	4.931E-11	-10.42201	0.767517	-1.161E-15
460	Mg+2	2.020E-04	1.874E-04	-3.84205	0.767517	-1.435E-10
471	Mn+3	1.344E-04	1.344E-04	-4.13007	0.551376	-2.307E-10
410	K+1	5.638E-04	5.626E-04	-3.27855	0.935992	-1.075E-10
500	Na+1	4.359E-04	4.346E-04	-3.39063	0.935992	-8.306E-11
140	CO3-2	2.084E-02	3.454E-05	-4.57660	0.767517	0.000E-01
150	Ca+2	1.723E-02	1.647E-04	-3.89833	0.767517	0.000E-01
2	H2O	0.000E-01	1.946E-03	-0.00034	1.000000	0.000E-01

PERCENTAGE DISTRIBUTION OF COMPONENTS AMONG
TYPE I and TYPE II (dissolved and adsorbed) species

H+1		100.1	PERCENT BOUND IN SPECIES	#3301400	HCO3 -
	1.2	PERCENT BOUND IN SPECIES	#3301401	H2CO3 AQ	
Sr+2		100.0	PERCENT BOUND IN SPECIES	# 800	Sr+2
Cl-1		100.0	PERCENT BOUND IN SPECIES	# 180	Cl-1
F-1		98.9	PERCENT BOUND IN SPECIES	# 270	F-1
NO3-1		100.0	PERCENT BOUND IN SPECIES	# 492	NO3-1
SO4-2		95.8	PERCENT BOUND IN SPECIES	# 732	SO4-2
	1.9	PERCENT BOUND IN SPECIES	#4607320	MgSO4 AQ	
	1.9	PERCENT BOUND IN SPECIES	#1507320	CaSO4 AQ	
Al+3		97.4	PERCENT BOUND IN SPECIES	# 303302	Al(OH)4 -
	2.6	PERCENT BOUND IN SPECIES	# 303303	Al(OH)3 AQ	
Zn+2		10.3	PERCENT BOUND IN SPECIES	# 950	Zn+2
	3.2	PERCENT BOUND IN SPECIES	#9503300	ZnOH +	
	12.0	PERCENT BOUND IN SPECIES	#9503301	Zn(OH)2 AQ	
	1.6	PERCENT BOUND IN SPECIES	#9501400	ZnHCO3 +	
	41.6	PERCENT BOUND IN SPECIES	#9501401	ZnCO3 AQ	
	30.7	PERCENT BOUND IN SPECIES	#9501402	Zn(CO3)2-2	
CrO4-2		98.8	PERCENT BOUND IN SPECIES	# 212	CrO4-2
Cu+2		5.3	PERCENT BOUND IN SPECIES	#2311400	CuCO3 AQ
	94.2	PERCENT BOUND IN SPECIES	#2313301	Cu(OH)2 AQ	
Pb+2		7.8	PERCENT BOUND IN SPECIES	#6001400	Pb(CO3)2-2
	1.4	PERCENT BOUND IN SPECIES	#6003300	PbOH +	
	90.0	PERCENT BOUND IN SPECIES	#6001401	PbCO3 AQ	
Mg+2		92.8	PERCENT BOUND IN SPECIES	# 460	Mg+2
	1.8	PERCENT BOUND IN SPECIES	#4601400	MgCO3 AQ	
	1.4	PERCENT BOUND IN SPECIES	#4601401	MgHCO3 +	
	3.9	PERCENT BOUND IN SPECIES	#4607320	MgSO4 AQ	
Mn+3		100.0	PERCENT BOUND IN SPECIES	# 471	Mn+3
K+1		99.8	PERCENT BOUND IN SPECIES	# 410	K+1
Na+1		99.7	PERCENT BOUND IN SPECIES	# 500	Na+1
CO3-2		1.9	PERCENT BOUND IN SPECIES	# 140	CO3-2
	95.6	PERCENT BOUND IN SPECIES	#3301400	HCO3 -	
Ca+2		91.7	PERCENT BOUND IN SPECIES	# 150	Ca+2
	1.3	PERCENT BOUND IN SPECIES	#1501400	CaHCO3 +	
	2.6	PERCENT BOUND IN SPECIES	#1501401	CaCO3 AQ	
	4.4	PERCENT BOUND IN SPECIES	#1507320	CaSO4 AQ	
H2O		12.7	PERCENT BOUND IN SPECIES	#3300020	OH-
	54.2	PERCENT BOUND IN SPECIES	# 303302	Al(OH)4 -	
	1.1	PERCENT BOUND IN SPECIES	# 303303	Al(OH)3 AQ	
	13.2	PERCENT BOUND IN SPECIES	#2313301	Cu(OH)2 AQ	
	2.2	PERCENT BOUND IN SPECIES	#9503300	ZnOH +	
	16.3	PERCENT BOUND IN SPECIES	#9503301	Zn(OH)2 AQ	

PART 5 of OUTPUT FILE

PC MINTEQA2 v3.10 DATE OF CALCULATIONS: 26-SEP-96 TIME: 11:12: 5

---------- PROVISIONAL MASS DISTRIBUTION ----------

IDX	NAME	DISSOLVED		SORBED		PRECIPITATED	
		MOL/KG	PERCENT	MOL/KG	PERCENT	MOL/KG	PERCENT
330	H+1	1.735E-03	100.0	0.000E-01	0.0	0.000E-01	0.0
800	Sr+2	1.715E-05	100.0	0.000E-01	0.0	0.000E-01	0.0
180	Cl-1	9.610E-05	100.0	0.000E-01	0.0	0.000E-01	0.0
270	F-1	5.274E-06	100.0	0.000E-01	0.0	0.000E-01	0.0
492	NO3-1	3.071E-05	100.0	0.000E-01	0.0	0.000E-01	0.0
732	SO4-2	4.172E-04	100.0	0.000E-01	0.0	0.000E-01	0.0
30	Al+3	4.085E-06	100.0	0.000E-01	0.0	0.000E-01	0.0
950	Zn+2	1.993E-05	100.0	0.000E-01	0.0	0.000E-01	0.0
212	CrO4-2	2.592E-07	100.0	0.000E-01	0.0	0.000E-01	0.0
231	Cu+2	2.050E-06	100.0	0.000E-01	0.0	0.000E-01	0.0
600	Pb+2	1.935E-08	100.0	0.000E-01	0.0	0.000E-01	0.0
460	Mg+2	2.020E-04	100.0	0.000E-01	0.0	0.000E-01	0.0
471	Mn+3	1.344E-04	100.0	0.000E-01	0.0	0.000E-01	0.0
410	K+1	5.638E-04	100.0	0.000E-01	0.0	0.000E-01	0.0
500	Na+1	4.359E-04	100.0	0.000E-01	0.0	0.000E-01	0.0
140	CO3-2	1.817E-03	100.0	0.000E-01	0.0	0.000E-01	0.0
150	Ca+2	1.796E-04	100.0	0.000E-01	0.0	0.000E-01	0.0
2	H2O	2.937E-05	100.0	0.000E-01	0.0	0.000E-01	0.0

Charge Balance: SPECIATED

Sum of CATIONS = 2.149E-03 Sum of ANIONS 2.760E-03

PERCENT DIFFERENCE = 1.244E+01 (ANIONS - CATIONS)/(ANIONS + CATIONS)

PROVISIONAL IONIC STRENGTH (m) = 3.670E-03

PC MINTEQA2 v3.10 DATE OF CALCULATIONS: 26-SEP-96 TIME: 11:12: 5

ITERATIONS= 14: SOLID BIXBYITE PRECIPITATES

PARAMETERS OF THE COMPONENT MOST OUT OF BALANCE:

ITER	NAME	TOTAL MOL	DIFF FXN	LOG ACTVTY	RESIDUAL
14	K+1	5.638E-04	-3.609E-05	-3.27855	3.603E-05
15	K+1	5.638E-04	3.415E-05	-3.25007	3.410E-05
16	K+1	5.638E-04	9.206E-07	-3.27536	8.643E-07
17	Mg+2	2.020E-04	2.353E-08	-3.82988	3.333E-09

ID	NAME	ANAL MOL	CALC MOL	LOG ACTVTY	GAMMA	DIFF FXN
330	H+1	5.686E-03	3.565E-09	-8.47421	0.941377	-9.818E-12
800	Sr+2	1.715E-05	1.715E-05	-4.87058	0.785334	5.949E-11
180	Cl-1	9.610E-05	9.609E-05	-4.04354	0.941377	8.332E-11
270	F-1	5.274E-06	5.215E-06	-5.30898	0.941377	4.573E-12
492	NO3-1	3.071E-05	3.071E-05	-4.53902	0.941377	2.662E-11
732	SO4-2	4.172E-04	3.961E-04	-3.50717	0.785334	1.375E-09
30	Al+3	4.085E-06	8.167E-17	-16.32408	0.580594	3.431E-12
950	Zn+2	1.993E-05	2.849E-06	-5.65019	0.785334	2.654E-11
212	CrO4-2	2.592E-07	2.557E-07	-6.69720	0.785334	8.898E-13
231	Cu+2	2.050E-06	1.329E-09	-8.98137	0.785334	-2.374E-14
600	Pb+2	1.935E-08	6.704E-11	-10.27864	0.785334	4.008E-15
460	Mg+2	2.020E-04	1.884E-04	-3.82993	0.785334	6.555E-10
500	Na+1	4.359E-04	4.347E-04	-3.38804	0.941377	3.776E-10
410	K+1	5.638E-04	5.625E-04	-3.27608	0.941377	4.888E-10
471	Mn+3	1.344E-04	3.225E-26	-25.72764	0.580594	-1.400E-19
150	Ca+2	1.723E-02	2.197E-04	-3.76302	0.785334	0.000E-01
140	CO3-2	2.084E-02	2.472E-05	-4.71191	0.785334	0.000E-01
2	H2O	0.000E-01	2.076E-03	-0.00034	1.000000	-1.355E-20

PERCENTAGE DISTRIBUTION OF COMPONENTS AMONG
TYPE I and TYPE II (dissolved and adsorbed) species

H+1		100.2	PERCENT BOUND IN SPECIES	#3301400	HCO3 -
	1.4	PERCENT BOUND IN SPECIES	#3301401	H2CO3 AQ	
Sr+2		100.0	PERCENT BOUND IN SPECIES	# 800	Sr+2
Cl-1		100.0	PERCENT BOUND IN SPECIES	# 180	Cl-1
F-1		98.9	PERCENT BOUND IN SPECIES	# 270	F-1
NO3-1		100.0	PERCENT BOUND IN SPECIES	# 492	NO3-1
SO4-2		94.9	PERCENT BOUND IN SPECIES	# 732	SO4-2
	2.0	PERCENT BOUND IN SPECIES	#4607320	MgSO4 AQ	
	2.6	PERCENT BOUND IN SPECIES	#1507320	CaSO4 AQ	
Al+3		96.9	PERCENT BOUND IN SPECIES	# 303302	Al(OH)4 -
	3.1	PERCENT BOUND IN SPECIES	# 303303	Al(OH)3 AQ	
Zn+2		14.3	PERCENT BOUND IN SPECIES	# 950	Zn+2
	3.9	PERCENT BOUND IN SPECIES	#9503300	ZnOH +	
	12.6	PERCENT BOUND IN SPECIES	#9503301	Zn(OH)2 AQ	
	2.0	PERCENT BOUND IN SPECIES	#9501400	ZnHCO3 +	
	43.5	PERCENT BOUND IN SPECIES	#9501401	ZnCO3 AQ	
	23.0	PERCENT BOUND IN SPECIES	#9501402	Zn(CO3)2-2	
CrO4-2		98.7	PERCENT BOUND IN SPECIES	# 212	CrO4-2
Cu+2		5.3	PERCENT BOUND IN SPECIES	#2311400	CuCO3 AQ
	94.3	PERCENT BOUND IN SPECIES	#2313301	Cu(OH)2 AQ	
Pb+2		5.7	PERCENT BOUND IN SPECIES	#6001400	Pb(CO3)2-2
	1.7	PERCENT BOUND IN SPECIES	#6003300	PbOH +	
	91.7	PERCENT BOUND IN SPECIES	#6001401	PbCO3 AQ	
Mg+2		93.3	PERCENT BOUND IN SPECIES	# 460	Mg+2
	1.4	PERCENT BOUND IN SPECIES	#4601400	MgCO3 AQ	
	1.3	PERCENT BOUND IN SPECIES	#4601401	MgHCO3 +	
	4.0	PERCENT BOUND IN SPECIES	#4607320	MgSO4 AQ	
Na+1		99.7	PERCENT BOUND IN SPECIES	# 500	Na+1
K+1		99.8	PERCENT BOUND IN SPECIES	# 410	K+1
Mn+3		100.0	PERCENT BOUND IN SPECIES	# 471	Mn+3
Ca+2		92.3	PERCENT BOUND IN SPECIES	# 150	Ca+2
	1.1	PERCENT BOUND IN SPECIES	#1501400	CaHCO3 +	
	2.0	PERCENT BOUND IN SPECIES	#1501401	CaCO3 AQ	
	4.6	PERCENT BOUND IN SPECIES	#1507320	CaSO4 AQ	
CO3-2		1.6	PERCENT BOUND IN SPECIES	# 140	CO3-2
	95.7	PERCENT BOUND IN SPECIES	#3301400	HCO3 -	
H2O		10.9	PERCENT BOUND IN SPECIES	#3300020	OH-
	54.4	PERCENT BOUND IN SPECIES	# 303302	Al(OH)4 -	
	1.3	PERCENT BOUND IN SPECIES	# 303303	Al(OH)3 AQ	
	13.3	PERCENT BOUND IN SPECIES	#2313301	Cu(OH)2 AQ	
	2.7	PERCENT BOUND IN SPECIES	#9503300	ZnOH +	
	17.2	PERCENT BOUND IN SPECIES	#9503301	Zn(OH)2 AQ	

---------- PROVISIONAL MASS DISTRIBUTION ----------

IDX	NAME	DISSOLVED		SORBED		PRECIPITATED	
		MOL/KG	PERCENT	MOL/KG	PERCENT	MOL/KG	PERCENT
330	H+1	1.476E-03	100.0	0.000E-01	0.0	0.000E-01	0.0
800	Sr+2	1.715E-05	100.0	0.000E-01	0.0	0.000E-01	0.0
180	Cl-1	9.610E-05	100.0	0.000E-01	0.0	0.000E-01	0.0
270	F-1	5.274E-06	100.0	0.000E-01	0.0	0.000E-01	0.0
492	NO3-1	3.071E-05	100.0	0.000E-01	0.0	0.000E-01	0.0
732	SO4-2	4.173E-04	100.0	0.000E-01	0.0	0.000E-01	0.0
30	Al+3	4.085E-06	100.0	0.000E-01	0.0	0.000E-01	0.0
950	Zn+2	1.993E-05	100.0	0.000E-01	0.0	0.000E-01	0.0
212	CrO4-2	2.592E-07	100.0	0.000E-01	0.0	0.000E-01	0.0
231	Cu+2	2.050E-06	100.0	0.000E-01	0.0	0.000E-01	0.0
600	Pb+2	1.935E-08	100.0	0.000E-01	0.0	0.000E-01	0.0
460	Mg+2	2.020E-04	100.0	0.000E-01	0.0	0.000E-01	0.0
500	Na+1	4.359E-04	100.0	0.000E-01	0.0	0.000E-01	0.0
410	K+1	5.638E-04	100.0	0.000E-01	0.0	0.000E-01	0.0
471	Mn+3	3.225E-26	0.0	0.000E-01	0.0	1.344E-04	100.0
150	Ca+2	2.381E-04	100.0	0.000E-01	0.0	0.000E-01	0.0
140	CO3-2	1.545E-03	100.0	0.000E-01	0.0	0.000E-01	0.0
2	H2O	2.914E-05	100.0	0.000E-01	0.0	0.000E-01	0.0

Charge Balance: SPECIATED

Sum of CATIONS = 1.860E-03 Sum of ANIONS 2.471E-03

PERCENT DIFFERENCE = 1.410E+01 (ANIONS - CATIONS)/(ANIONS + CATIONS)

PROVISIONAL IONIC STRENGTH (m) = 3.019E-03

PC MINTEQA2 v3.10 DATE OF CALCULATIONS: 26-SEP-96 TIME: 11:12: 6

ITERATIONS= 18: SOLID DIASPORE PRECIPITATES

PARAMETERS OF THE COMPONENT MOST OUT OF BALANCE:

ITER	NAME	TOTAL MOL	DIFF FXN	LOG ACTVTY	RESIDUAL
18	Na+1	4.359E-04	-2.553E-05	-3.38804	2.549E-05
19	Na+1	4.359E-04	2.636E-05	-3.36199	2.631E-05
20	Na+1	4.359E-04	7.183E-07	-3.38731	6.747E-07
21	Mg+2	2.020E-04	2.372E-08	-3.82988	3.529E-09

ID	NAME	ANAL MOL	CALC MOL	LOG ACTVTY	GAMMA	DIFF FXN
330	H+1	5.686E-03	3.559E-09	-8.47489	0.941395	-3.619E-12
800	Sr+2	1.715E-05	1.715E-05	-4.87055	0.785394	5.992E-11
180	Cl-1	9.610E-05	9.609E-05	-4.04353	0.941395	8.392E-11
270	F-1	5.274E-06	5.215E-06	-5.30897	0.941395	4.606E-12
492	NO3-1	3.071E-05	3.071E-05	-4.53902	0.941395	2.681E-11
732	SO4-2	4.172E-04	3.961E-04	-3.50710	0.785394	1.385E-09
410	K+1	5.638E-04	5.625E-04	-3.27607	0.941395	4.924E-10
950	Zn+2	1.993E-05	2.840E-06	-5.65159	0.785394	2.675E-11
212	CrO4-2	2.592E-07	2.557E-07	-6.69716	0.785394	8.963E-13
231	Cu+2	2.050E-06	1.325E-09	-8.98271	0.785394	-2.388E-14
600	Pb+2	1.935E-08	6.682E-11	-10.28003	0.785394	4.048E-15
460	Mg+2	2.020E-04	1.884E-04	-3.82993	0.785394	6.602E-10
500	Na+1	4.359E-04	4.347E-04	-3.38803	0.941395	3.804E-10
30	Al+3	4.085E-06	4.843E-19	-18.55098	0.580693	0.000E-01
150	Ca+2	1.723E-02	2.191E-04	-3.76436	0.785394	0.000E-01
140	CO3-2	2.084E-02	2.479E-05	-4.71057	0.785394	0.000E-01
471	Mn+3	1.344E-04	3.209E-26	-25.72965	0.580693	0.000E-01
2	H2O	0.000E-01	2.081E-03	-0.00034	1.000000	0.000E-01

PERCENTAGE DISTRIBUTION OF COMPONENTS AMONG
TYPE I and TYPE II (dissolved and adsorbed) species

H+1		99.1	PERCENT BOUND IN SPECIES #3301400	HCO3 -
	1.4	PERCENT BOUND IN SPECIES #3301401	H2CO3 AQ	
Sr+2		100.0	PERCENT BOUND IN SPECIES # 800	Sr+2
Cl-1		100.0	PERCENT BOUND IN SPECIES # 180	Cl-1
F-1		98.9	PERCENT BOUND IN SPECIES # 270	F-1
NO3-1		100.0	PERCENT BOUND IN SPECIES # 492	NO3-1
SO4-2		94.9	PERCENT BOUND IN SPECIES # 732	SO4-2
	2.0	PERCENT BOUND IN SPECIES #4607320	MgSO4 AQ	
	2.6	PERCENT BOUND IN SPECIES #1507320	CaSO4 AQ	
K+1		99.8	PERCENT BOUND IN SPECIES # 410	K+1
Zn+2		14.3	PERCENT BOUND IN SPECIES # 950	Zn+2
	3.9	PERCENT BOUND IN SPECIES #9503300	ZnOH +	
	12.6	PERCENT BOUND IN SPECIES #9503301	Zn(OH)2 AQ	
	1.9	PERCENT BOUND IN SPECIES #9501400	ZnHCO3 +	
	43.5	PERCENT BOUND IN SPECIES #9501401	ZnCO3 AQ	
	23.1	PERCENT BOUND IN SPECIES #9501402	Zn(CO3)2-2	
CrO4-2		98.7	PERCENT BOUND IN SPECIES # 212	CrO4-2
Cu+2		5.3	PERCENT BOUND IN SPECIES #2311400	CuCO3 AQ
	94.3	PERCENT BOUND IN SPECIES #2313301	Cu(OH)2 AQ	
Pb+2		5.7	PERCENT BOUND IN SPECIES #6001400	Pb(CO3)2-2
	1.7	PERCENT BOUND IN SPECIES #6003300	PbOH +	
	91.7	PERCENT BOUND IN SPECIES #6001401	PbCO3 AQ	
Mg+2		93.3	PERCENT BOUND IN SPECIES # 460	Mg+2
	1.4	PERCENT BOUND IN SPECIES #4601400	MgCO3 AQ	
	1.3	PERCENT BOUND IN SPECIES #4601401	MgHCO3 +	
	4.0	PERCENT BOUND IN SPECIES #4607320	MgSO4 AQ	
Na+1		99.7	PERCENT BOUND IN SPECIES # 500	Na+1
Al+3		96.9	PERCENT BOUND IN SPECIES # 303302	Al(OH)4 -
	3.1	PERCENT BOUND IN SPECIES # 303303	Al(OH)3 AQ	
Ca+2		92.3	PERCENT BOUND IN SPECIES # 150	Ca+2
	1.1	PERCENT BOUND IN SPECIES #1501400	CaHCO3 +	
	2.0	PERCENT BOUND IN SPECIES #1501401	CaCO3 AQ	
	4.6	PERCENT BOUND IN SPECIES #1507320	CaSO4 AQ	
CO3-2		1.6	PERCENT BOUND IN SPECIES # 140	CO3-2
	95.7	PERCENT BOUND IN SPECIES #3301400	HCO3 -	
Mn+3		100.0	PERCENT BOUND IN SPECIES # 471	Mn+3
H2O		24.4	PERCENT BOUND IN SPECIES #3300020	OH-
	29.7	PERCENT BOUND IN SPECIES #2313301	Cu(OH)2 AQ	
	5.9	PERCENT BOUND IN SPECIES #9503300	ZnOH +	
	38.4	PERCENT BOUND IN SPECIES #9503301	Zn(OH)2 AQ	

---------- PROVISIONAL MASS DISTRIBUTION ----------

IDX	NAME	DISSOLVED MOL/KG	DISSOLVED PERCENT	SORBED MOL/KG	SORBED PERCENT	PRECIPITATED MOL/KG	PRECIPITATED PERCENT
330	H+1	1.494E-03	100.0	0.000E-01	0.0	0.000E-01	0.0
800	Sr+2	1.715E-05	100.0	0.000E-01	0.0	0.000E-01	0.0
180	Cl-1	9.610E-05	100.0	0.000E-01	0.0	0.000E-01	0.0
270	F-1	5.274E-06	100.0	0.000E-01	0.0	0.000E-01	0.0
492	NO3-1	3.071E-05	100.0	0.000E-01	0.0	0.000E-01	0.0
732	SO4-2	4.173E-04	100.0	0.000E-01	0.0	0.000E-01	0.0
410	K+1	5.638E-04	100.0	0.000E-01	0.0	0.000E-01	0.0
950	Zn+2	1.993E-05	100.0	0.000E-01	0.0	0.000E-01	0.0
212	CrO4-2	2.592E-07	100.0	0.000E-01	0.0	0.000E-01	0.0
231	Cu+2	2.050E-06	100.0	0.000E-01	0.0	0.000E-01	0.0
600	Pb+2	1.935E-08	100.0	0.000E-01	0.0	0.000E-01	0.0
460	Mg+2	2.020E-04	100.0	0.000E-01	0.0	0.000E-01	0.0
500	Na+1	4.359E-04	100.0	0.000E-01	0.0	0.000E-01	0.0
30	Al+3	2.438E-08	0.6	0.000E-01	0.0	4.061E-06	99.4
150	Ca+2	2.374E-04	100.0	0.000E-01	0.0	0.000E-01	0.0
140	CO3-2	1.547E-03	100.0	0.000E-01	0.0	0.000E-01	0.0
471	Mn+3	3.209E-26	0.0	0.000E-01	0.0	1.344E-04	100.0
2	H2O	1.303E-05	100.0	0.000E-01	0.0	0.000E-01	0.0

Charge Balance: SPECIATED

Sum of CATIONS = 1.859E-03 Sum of ANIONS 2.469E-03

PERCENT DIFFERENCE = 1.411E+01 (ANIONS - CATIONS)/(ANIONS + CATIONS)

PROVISIONAL IONIC STRENGTH (m) = 3.017E-03

PC MINTEQA2 v3.10 DATE OF CALCULATIONS: 26-SEP-96 TIME: 11:12: 7

ITERATIONS= 22: SOLID TENORITE PRECIPITATES

PARAMETERS OF THE COMPONENT MOST OUT OF BALANCE:

ITER	NAME	TOTAL MOL	DIFF FXN	LOG ACTVTY	RESIDUAL
22	Mg+2	2.020E-04	-4.057E-05	-3.82993	4.055E-05
23	Mg+2	2.020E-04	4.920E-05	-3.73703	4.918E-05
24	Mg+2	2.020E-04	1.699E-06	-3.82637	1.679E-06
25	Mg+2	2.020E-04	2.372E-08	-3.82988	3.528E-09

ID	NAME	ANAL MOL	CALC MOL	LOG ACTVTY	GAMMA	DIFF FXN
330	H+1	5.686E-03	3.559E-09	-8.47489	0.941395	-3.661E-12
800	Sr+2	1.715E-05	1.715E-05	-4.87055	0.785394	5.992E-11
180	Cl-1	9.610E-05	9.609E-05	-4.04353	0.941395	8.392E-11
270	F-1	5.274E-06	5.215E-06	-5.30897	0.941395	4.606E-12
492	NO3-1	3.071E-05	3.071E-05	-4.53902	0.941395	2.681E-11
732	SO4-2	4.172E-04	3.961E-04	-3.50710	0.785394	1.385E-09
410	K+1	5.638E-04	5.625E-04	-3.27607	0.941395	4.923E-10
950	Zn+2	1.993E-05	2.840E-06	-5.65159	0.785394	2.674E-11
212	CrO4-2	2.592E-07	2.557E-07	-6.69716	0.785394	8.962E-13
500	Na+1	4.359E-04	4.347E-04	-3.38803	0.941395	3.803E-10
600	Pb+2	1.935E-08	6.682E-11	-10.28003	0.785394	4.047E-15
460	Mg+2	2.020E-04	1.884E-04	-3.82993	0.785394	6.601E-10
231	Cu+2	2.050E-06	5.963E-10	-9.32943	0.785394	0.000E-01
150	Ca+2	1.723E-02	2.191E-04	-3.76436	0.785394	0.000E-01
140	CO3-2	2.084E-02	2.479E-05	-4.71057	0.785394	0.000E-01
471	Mn+3	1.344E-04	3.209E-26	-25.72965	0.580694	0.000E-01
30	Al+3	4.085E-06	4.843E-19	-18.55098	0.580694	0.000E-01
2	H2O	0.000E-01	2.082E-03	-0.00034	1.000000	0.000E-01

PERCENTAGE DISTRIBUTION OF COMPONENTS AMONG
TYPE I and TYPE II (dissolved and adsorbed) species

H+1		98.9	PERCENT BOUND IN SPECIES #3301400	HCO3 -
	1.4	PERCENT BOUND IN SPECIES #3301401	H2CO3 AQ	
Sr+2		100.0	PERCENT BOUND IN SPECIES # 800	Sr+2
Cl-1		100.0	PERCENT BOUND IN SPECIES # 180	Cl-1
F-1		98.9	PERCENT BOUND IN SPECIES # 270	F-1
NO3-1		100.0	PERCENT BOUND IN SPECIES # 492	NO3-1
SO4-2		94.9	PERCENT BOUND IN SPECIES # 732	SO4-2
	2.0	PERCENT BOUND IN SPECIES #4607320	MgSO4 AQ	
	2.6	PERCENT BOUND IN SPECIES #1507320	CaSO4 AQ	
K+1		99.8	PERCENT BOUND IN SPECIES # 410	K+1
Zn+2		14.3	PERCENT BOUND IN SPECIES # 950	Zn+2
	3.9	PERCENT BOUND IN SPECIES #9503300	ZnOH +	
	12.6	PERCENT BOUND IN SPECIES #9503301	Zn(OH)2 AQ	
	1.9	PERCENT BOUND IN SPECIES #9501400	ZnHCO3 +	
	43.5	PERCENT BOUND IN SPECIES #9501401	ZnCO3 AQ	
	23.1	PERCENT BOUND IN SPECIES #9501402	Zn(CO3)2-2	
CrO4-2		98.7	PERCENT BOUND IN SPECIES # 212	CrO4-2
Na+1		99.7	PERCENT BOUND IN SPECIES # 500	Na+1
Pb+2		5.7	PERCENT BOUND IN SPECIES #6001400	Pb(CO3)2-2
	1.7	PERCENT BOUND IN SPECIES #6003300	PbOH +	
	91.7	PERCENT BOUND IN SPECIES #6001401	PbCO3 AQ	
Mg+2		93.3	PERCENT BOUND IN SPECIES # 460	Mg+2
	1.4	PERCENT BOUND IN SPECIES #4601400	MgCO3 AQ	
	1.3	PERCENT BOUND IN SPECIES #4601401	MgHCO3 +	
	4.0	PERCENT BOUND IN SPECIES #4607320	MgSO4 AQ	
Cu+2		5.3	PERCENT BOUND IN SPECIES #2311400	CuCO3 AQ
	94.3	PERCENT BOUND IN SPECIES #2313301	Cu(OH)2 AQ	
Ca+2		92.3	PERCENT BOUND IN SPECIES # 150	Ca+2
	1.1	PERCENT BOUND IN SPECIES #1501400	CaHCO3 +	
	2.0	PERCENT BOUND IN SPECIES #1501401	CaCO3 AQ	
	4.6	PERCENT BOUND IN SPECIES #1507320	CaSO4 AQ	
CO3-2		1.6	PERCENT BOUND IN SPECIES # 140	CO3-2
	95.7	PERCENT BOUND IN SPECIES #3301400	HCO3 -	
Mn+3		100.0	PERCENT BOUND IN SPECIES # 471	Mn+3
Al+3		96.9	PERCENT BOUND IN SPECIES # 303302	Al(OH)4 -
	3.1	PERCENT BOUND IN SPECIES # 303303	Al(OH)3 AQ	
H2O		29.2	PERCENT BOUND IN SPECIES #3300020	OH-
	16.0	PERCENT BOUND IN SPECIES #2313301	Cu(OH)2 AQ	
	7.1	PERCENT BOUND IN SPECIES #9503300	ZnOH +	
	45.9	PERCENT BOUND IN SPECIES #9503301	Zn(OH)2 AQ	

---------- PROVISIONAL MASS DISTRIBUTION ----------

IDX	NAME	DISSOLVED MOL/KG	DISSOLVED PERCENT	SORBED MOL/KG	SORBED PERCENT	PRECIPITATED MOL/KG	PRECIPITATED PERCENT
330	H+1	1.496E-03	100.0	0.000E-01	0.0	0.000E-01	0.0
800	Sr+2	1.715E-05	100.0	0.000E-01	0.0	0.000E-01	0.0
180	Cl-1	9.610E-05	100.0	0.000E-01	0.0	0.000E-01	0.0
270	F-1	5.274E-06	100.0	0.000E-01	0.0	0.000E-01	0.0
492	NO3-1	3.071E-05	100.0	0.000E-01	0.0	0.000E-01	0.0
732	SO4-2	4.173E-04	100.0	0.000E-01	0.0	0.000E-01	0.0
410	K+1	5.638E-04	100.0	0.000E-01	0.0	0.000E-01	0.0
950	Zn+2	1.993E-05	100.0	0.000E-01	0.0	0.000E-01	0.0
212	CrO4-2	2.592E-07	100.0	0.000E-01	0.0	0.000E-01	0.0
500	Na+1	4.359E-04	100.0	0.000E-01	0.0	0.000E-01	0.0
600	Pb+2	1.935E-08	100.0	0.000E-01	0.0	0.000E-01	0.0
460	Mg+2	2.020E-04	100.0	0.000E-01	0.0	0.000E-01	0.0
231	Cu+2	9.226E-07	45.0	0.000E-01	0.0	1.127E-06	55.0
150	Ca+2	2.374E-04	100.0	0.000E-01	0.0	0.000E-01	0.0
140	CO3-2	1.547E-03	100.0	0.000E-01	0.0	0.000E-01	0.0
471	Mn+3	3.209E-26	0.0	0.000E-01	0.0	1.344E-04	100.0
30	Al+3	2.438E-08	0.6	0.000E-01	0.0	4.061E-06	99.4
2	H2O	1.090E-05	100.0	0.000E-01	0.0	0.000E-01	0.0

Charge Balance: SPECIATED

Sum of CATIONS = 1.859E-03 Sum of ANIONS 2.469E-03

PERCENT DIFFERENCE = 1.411E+01 (ANIONS - CATIONS)/(ANIONS + CATIONS)

PROVISIONAL IONIC STRENGTH (m) = 3.017E-03

PC MINTEQA2 v3.10 DATE OF CALCULATIONS: 26-SEP-96 TIME: 11:12: 8

ITERATIONS= 26: SOLID ZINCITE PRECIPITATES

PART 3 of OUTPUT FILE

PC MINTEQA2 v3.10 DATE OF CALCULATIONS: 26-SEP-96 TIME: 11:12: 9

PARAMETERS OF THE COMPONENT MOST OUT OF BALANCE:

ITER	NAME	TOTAL MOL	DIFF FXN	LOG ACTVTY	RESIDUAL
26	Pb+2	1.935E-08	-2.617E-10	-10.28003	2.598E-10
27	Pb+2	1.935E-08	2.605E-10	-10.27745	2.586E-10
28	Pb+2	1.935E-08	9.147E-12	-10.28007	7.212E-12
29	CrO4-2	2.592E-07	3.185E-11	-6.69703	5.930E-12

ID	NAME	ANAL MOL	CALC MOL	LOG ACTVTY	GAMMA	DIFF FXN
330	H+1	5.686E-03	3.558E-09	-8.47499	0.941437	5.247E-11
800	Sr+2	1.715E-05	1.715E-05	-4.87047	0.785534	6.057E-11
180	Cl-1	9.610E-05	9.610E-05	-4.04351	0.941437	8.483E-11
270	F-1	5.274E-06	5.215E-06	-5.30895	0.941437	4.656E-12
492	NO3-1	3.071E-05	3.071E-05	-4.53900	0.941437	2.710E-11
732	SO4-2	4.172E-04	3.962E-04	-3.50697	0.785534	1.400E-09
410	K+1	5.638E-04	5.625E-04	-3.27605	0.941437	4.977E-10
460	Mg+2	2.020E-04	1.884E-04	-3.82987	0.785534	6.673E-10
212	CrO4-2	2.592E-07	2.557E-07	-6.69709	0.785534	9.059E-13
500	Na+1	4.359E-04	4.347E-04	-3.38801	0.941437	3.845E-10
600	Pb+2	1.935E-08	6.677E-11	-10.28025	0.785534	4.092E-15
950	Zn+2	1.993E-05	1.973E-06	-5.80964	0.785534	0.000E-01
150	Ca+2	1.723E-02	2.189E-04	-3.76457	0.785534	0.000E-01
140	CO3-2	2.084E-02	2.480E-05	-4.71036	0.785534	0.000E-01
471	Mn+3	1.344E-04	3.206E-26	-25.72997	0.580926	0.000E-01
30	Al+3	4.085E-06	4.837E-19	-18.55130	0.580926	0.000E-01
231	Cu+2	2.050E-06	5.959E-10	-9.32964	0.785534	0.000E-01
2	H2O	0.000E-01	2.083E-03	-0.00034	1.000000	0.000E-01

PERCENTAGE DISTRIBUTION OF COMPONENTS AMONG
TYPE I and TYPE II (dissolved and adsorbed) species

H+1		98.8	PERCENT BOUND IN SPECIES #3301400		HCO3 -
	1.4	PERCENT BOUND IN SPECIES #3301401		H2CO3 AQ	
Sr+2		100.0	PERCENT BOUND IN SPECIES #	800	Sr+2
Cl-1		100.0	PERCENT BOUND IN SPECIES #	180	Cl-1
F-1		98.9	PERCENT BOUND IN SPECIES #	270	F-1
NO3-1		100.0	PERCENT BOUND IN SPECIES #	492	NO3-1
SO4-2		94.9	PERCENT BOUND IN SPECIES #	732	SO4-2
	2.0	PERCENT BOUND IN SPECIES #4607320		MgSO4 AQ	
	2.6	PERCENT BOUND IN SPECIES #1507320		CaSO4 AQ	
K+1		99.8	PERCENT BOUND IN SPECIES #	410	K+1
Mg+2		93.3	PERCENT BOUND IN SPECIES #	460	Mg+2
	1.4	PERCENT BOUND IN SPECIES #4601400		MgCO3 AQ	
	1.3	PERCENT BOUND IN SPECIES #4601401		MgHCO3 +	
	4.1	PERCENT BOUND IN SPECIES #4607320		MgSO4 AQ	
CrO4-2		98.7	PERCENT BOUND IN SPECIES #	212	CrO4-2
Na+1		99.7	PERCENT BOUND IN SPECIES #	500	Na+1
Pb+2		5.7	PERCENT BOUND IN SPECIES #6001400		Pb(CO3)2-2
	1.7	PERCENT BOUND IN SPECIES #6003300		PbOH +	
	91.7	PERCENT BOUND IN SPECIES #6001401		PbCO3 AQ	
Zn+2		14.2	PERCENT BOUND IN SPECIES #	950	Zn+2
	3.9	PERCENT BOUND IN SPECIES #9503300		ZnOH +	
	12.6	PERCENT BOUND IN SPECIES #9503301		Zn(OH)2 AQ	
	1.9	PERCENT BOUND IN SPECIES #9501400		ZnHCO3 +	
	43.5	PERCENT BOUND IN SPECIES #9501401		ZnCO3 AQ	
	23.1	PERCENT BOUND IN SPECIES #9501402		Zn(CO3)2-2	
Ca+2		92.3	PERCENT BOUND IN SPECIES #	150	Ca+2
	1.1	PERCENT BOUND IN SPECIES #1501400		CaHCO3 +	
	2.0	PERCENT BOUND IN SPECIES #1501401		CaCO3 AQ	
	4.6	PERCENT BOUND IN SPECIES #1507320		CaSO4 AQ	
CO3-2		1.6	PERCENT BOUND IN SPECIES #	140	CO3-2
	96.0	PERCENT BOUND IN SPECIES #3301400		HCO3 -	
Mn+3		100.0	PERCENT BOUND IN SPECIES #	471	Mn+3
Al+3		96.9	PERCENT BOUND IN SPECIES # 303302		Al(OH)4 -
	3.1	PERCENT BOUND IN SPECIES # 303303		Al(OH)3 AQ	
Cu+2		5.3	PERCENT BOUND IN SPECIES #2311400		CuCO3 AQ
	94.3	PERCENT BOUND IN SPECIES #2313301		Cu(OH)2 AQ	
H2O		34.8	PERCENT BOUND IN SPECIES #3300020		OH-
	1.0	PERCENT BOUND IN SPECIES # 303302		Al(OH)4 -	
	19.0	PERCENT BOUND IN SPECIES #2313301		Cu(OH)2 AQ	
	5.9	PERCENT BOUND IN SPECIES #9503300		ZnOH +	
	38.1	PERCENT BOUND IN SPECIES #9503301		Zn(OH)2 AQ	

PART 5 of OUTPUT FILE

PC MINTEQA2 v3.10 DATE OF CALCULATIONS: 26-SEP-96 TIME: 11:12: 9

---------- EQUILIBRATED MASS DISTRIBUTION ----------

IDX	NAME	DISSOLVED		SORBED		PRECIPITATED	
		MOL/KG	PERCENT	MOL/KG	PERCENT	MOL/KG	PERCENT
330	H+1	1.498E-03	100.0	0.000E-01	0.0	0.000E-01	0.0
800	Sr+2	1.715E-05	100.0	0.000E-01	0.0	0.000E-01	0.0
180	Cl-1	9.610E-05	100.0	0.000E-01	0.0	0.000E-01	0.0
270	F-1	5.274E-06	100.0	0.000E-01	0.0	0.000E-01	0.0
492	NO3-1	3.071E-05	100.0	0.000E-01	0.0	0.000E-01	0.0
732	SO4-2	4.173E-04	100.0	0.000E-01	0.0	0.000E-01	0.0
410	K+1	5.638E-04	100.0	0.000E-01	0.0	0.000E-01	0.0
460	Mg+2	2.020E-04	100.0	0.000E-01	0.0	0.000E-01	0.0
212	CrO4-2	2.592E-07	100.0	0.000E-01	0.0	0.000E-01	0.0
500	Na+1	4.359E-04	100.0	0.000E-01	0.0	0.000E-01	0.0
600	Pb+2	1.935E-08	100.0	0.000E-01	0.0	0.000E-01	0.0
950	Zn+2	1.385E-05	69.5	0.000E-01	0.0	6.073E-06	30.5
150	Ca+2	2.372E-04	100.0	0.000E-01	0.0	0.000E-01	0.0
140	CO3-2	1.542E-03	100.0	0.000E-01	0.0	0.000E-01	0.0
471	Mn+3	3.206E-26	0.0	0.000E-01	0.0	1.344E-04	100.0
30	Al+3	2.438E-08	0.6	0.000E-01	0.0	4.061E-06	99.4
231	Cu+2	9.226E-07	45.0	0.000E-01	0.0	1.127E-06	55.0
2	H2O	9.136E-06	100.0	0.000E-01	0.0	0.000E-01	0.0

Charge Balance: SPECIATED

Sum of CATIONS = 1.856E-03 Sum of ANIONS 2.467E-03

PERCENT DIFFERENCE = 1.412E+01 (ANIONS - CATIONS)/(ANIONS + CATIONS)

EQUILIBRIUM IONIC STRENGTH (m) = 3.012E-03

EQUILIBRIUM pH = 8.475

DATE ID NUMBER: 960926
TIME ID NUMBER: 11120997

APPENDIX D - WATERS STUDY, CHEMGOLD INC., IMPERIAL PROJECT, IMPERIAL COUNTY, CALIFORNIA

CHEMGOLD, INC. IMPERIAL PROJECT
IMPERIAL COUNTY, CALIFORNIA

WATERS STUDY

EMA Report No. 0959-04
March 1996

Prepared for:

Chemgold, Inc.
P.O. Box 758
Winterhaven, California 92283

CHEMGOLD, INC. IMPERIAL PROJECT
IMPERIAL COUNTY, CALIFORNIA

WATERS STUDY

EMA Report No. 0959-04
March 1996

Prepared for:

Chemgold, Inc.
P.O. Box 758
Winterhaven, California 92283

LIMITATIONS

This report was prepared by Environmental Management Associates, Inc. (EMA) in conformance with the scope of work prescribed by our CLIENT. The work has been conducted in an objective and unbiased manner and in accord with generally accepted professional practice for this type of work. No other warranty, either expressed or implied, is made as to the findings, recommendations, specifications or opinions presented herein.

ENVIRONMENTAL MANAGEMENT ASSOCIATES, INC.

Joan Reynolds
Associate Botanist

Richard F. DeLong
Principal Specialist

Dwight L. Carey, D.Env.
Principal

Corporate Office:
1698 Greenbriar Lane, Suite 210, Brea, California 92621-5919
(714) 529-3695 FAX: (714) 529-8543

Regional Office:
100 W. Grove Street, Suite 100, Reno, Nevada 89509-4026
(702) 828-3939 FAX: (702) 828-3940

CHEMGOLD, INC. IMPERIAL PROJECT
IMPERIAL COUNTY, CALIFORNIA

WATERS STUDY

TABLE OF CONTENTS

		Page
LIMITATIONS		i
1.	OVERVIEW	1
	1.1. Study Objectives	1
	1.2. Project Location and Site Characteristics	1
2.	DEFINITIONS	2
	2.1. Definition of "Waters"	2
	2.1.1. Ordinary High Water Mark	2
	2.1.2. Wetlands	3
	2.2. Definition of "Waters of the United States"	4
	2.2.1. Waters of the United States	4
	2.2.2. "Isolated" Waters of the United States	4
3.	WATERCOURSES ASSESSMENT	4
	3.1. Methodology	4
	3.2. Watercourse Descriptions	6
	3.2.1. Watercourse A	6
	3.2.2. Watercourse C	9
	3.2.3. Watercourse D	11
	3.2.4. Watercourse E	12
4.	Determination of ACOE Jurisdiction	14
	4.1. Wetlands Assessment	14
	4.2. Determination of "Waters"	14
	4.3. Determination of Jurisdictional "Waters of the United States"	15
5.	AFFECTS ASSESSMENT	15
6.	REFERENCES	17

LIST OF FIGURES

Page

Figure 1: Imperial Project General Location Map 19
Figure 2: Imperial Project Vicinity Map 20
Figure 3: Topographic Map of the Imperial Project Mine and Process Area . . . 21

LIST OF TABLES

Page

Table 1: Length, Width and Acreage of Watercourse A and Tributaries Within the Mine and Process Area 8
Table 2: Length, Width and Acreage of Watercourse C and Tributaries Within the Mine and Process Area 10
Table 3: Length, Width and Acreage of Watercourse D and Tributaries Within the Mine and Process Area 11
Table 4: Length, Width and Acreage of Watercourse E and Tributaries Within the Mine and Process Area 13
Table 5: Summary of Jurisdictional "Waters of the United States" in the Mine and Process Area 16
Table 6: Calculation of Jurisdictional "Waters of the United States" Affected by the Imperial Project 18

PLATES

Plate 1 Delineation Map of "Waters" Within the Imperial Mine and Process Area
Plate 2 Map of "Waters of the United States" Within the Imperial Project Mine and Process Area Showing Trees within the OHWM Channels
Plate 3 Map of "Waters of the United States" Showing Those Proposed Project Facilities Which May Result in Dredge or Fill to Jurisdictional "Waters of the United States"

APPENDICES

APPENDIX A FIELD DATA FORMS
APPENDIX B PHOTOGRAPHS
APPENDIX C WATERCOURSE PLANT SPECIES LIST

CHEMGOLD, INC. IMPERIAL PROJECT
IMPERIAL COUNTY, CALIFORNIA

WATERS STUDY

1. OVERVIEW

1.1. Study Objectives

This report presents the findings of surveys performed to identify waters of the United States, including wetlands, in and around the proposed Chemgold, Inc. (Chemgold) Imperial Project (Project) mine and process area, Imperial County, California. This report also provides the applicable regulatory definitions for waters of the United States, including wetlands, and identifies potentially impacted waters of the United States within the Project mine and process area boundaries.

1.2. Project Location and Site Characteristics

The proposed Project is located in eastern Imperial County, California, near Indian Pass, south of the Chocolate Mountains and west of Picacho Peak (see Figure 1 and Figure 2). The Project area consists of a series of gently rolling ridgelines and upland areas interspersed with a series of slightly incised subparallel ephemeral drainage channels which all gently slope from north-northeast to south-southwest at approximately one (1) percent. Elevations in the Project mine and process area range from 760 to 925 feet above mean sea level.

The Project area is a desert environment characterized by very hot summers and mild winters. Precipitation in the area is low, with the average annual rainfall measured at the neighboring Gold Rock Ranch being only approximately 3.60 inches per year (GSI/Water, 1993). Precipitation tends to occur in short, intense events in the Sonoran Desert. All surface watercourses and drainages in the mine and process area are ephemeral, with flows occurring only during and immediately following major precipitation events. Because these infrequent major precipitation events create channel marks and bank scouring lines in the watercourses of the area, the high water marks and channelization of the watercourses resulting from major storm event runoff may not represent the "ordinary" high water marks for watercourses in this desert environ.

The Project area is relatively undisturbed, with only a few roads and trails and minor disturbances from historic and ongoing mineral exploration activities (Bamberg and Hanne, 1995). The upland areas support a widely spaced creosote bush scrub plant community, dominated by creosote bush (*Larrea tridentata*), burrobush (*Ambrosia dumosa*), ocotillo (*Fouquieria splendens*), and smaller numbers of desert shrubs and forbs (Bamberg and Hanne, 1995; Rado, 1995). The ephemeral stream channels and the areas adjacent are dominated by a sparse community of desert ironwood (*Olneya tesota*), palo verde (*Cercidium floridum*), cat claw (*Acacia greggii*), burrowbush

(*Ambrosia dumosa*), brittle-bush (*Encelia farinosa*), also with a few other desert shrubs and forbs. Much of the upland areas are covered by well-developed desert pavement of gravel- to cobble-size rocks.

A total of 44 bird species were observed during site surveys, including year-round residents, such as Gambel's quail (*Lophortyx gambelii*), as well as seasonal migrants, such as white crowned sparrows (*Zonotrichia leucophrys*) (Rado, 1995). Several species of game bird are present within the Project area, including Gambel's quail, mourning dove (*Zenaida macroura*) and white-winged dove (*Zenaida asiatica*), which were observed in moderate-to-larger ephemeral stream channels. A single species listed by the U.S. Fish and Wildlife Service (USFWS) as endangered, the desert tortoise (*Gopherus agassizii*), was observed throughout the Project mine and process area and along the access and transmission corridors. For reasons which are not known, most of the individuals and sign were observed in the eastern half of the Project mine and process area (Rado, 1995).

2. DEFINITIONS

2.1. Definition of "Waters"

The U.S. Army Corps of Engineers (ACOE), under Section 404 of the Clean Water Act, regulates the discharge of dredged or fill material into "waters of the United States" (33 U.S.C. 1251-1376). "Waters" are broadly defined at 33 CFR 328.2 to include: territorial seas; tidal waters; and non-tidal waters, including intermittent watercourses (33 CFR 328.3(a)(3)) and tributaries to such watercourses (33 CFR 328.3(a)(5)), with no stated limit on the order of tributaries included as "waters." The limits of ACOE jurisdiction on "non-tidal waters of the United States" extends to the "ordinary high water mark" (OHWM), in the absence of adjacent wetlands (33 CFR 328.4(c)(1)); or beyond the OHWM to the limits of the adjacent wetlands, when adjacent wetlands are present (33 CFR 328.4(c)(2)); or to the limits of the wetlands when only wetlands are present (33 CFR 328.4(c)(3)).

2.1.1. Ordinary High Water Mark

The lateral limits of ACOE jurisdiction for non-tidal watercourses (without adjacent wetland areas) is the "ordinary high water mark" (OHWM). OHWM is defined in 33 CFR 328.3(e) as "... that line on the shore established by the fluctuations of water and indicated by physical characteristics such as clear, natural line impressed on the bank, shelving, changes in the character of soil, destruction of terrestrial vegetation, the presence of litter and debris, or other appropriate means that consider the characteristics of the surrounding areas." The bank-to-bank extent of the channel that contains the water-flow during a normal rainfall year generally serves as a good first approximation of the OHWM

and thus, the lateral limit of the ACOE jurisdiction in areas devoid of wetlands. The upstream limit of "waters" is generally accepted as the point where the OHWM is no longer perceptible.

2.1.2. Wetlands

Wetlands are included as one element of the definition of "waters" (see 33 CFR 328.3(a)(2), 33 CFR 328.3(a)(3), and 33 CFR 328.3(a)(7)). As defined at 33 CFR 328.3(b), "wetlands" are: "those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions." The edge of perennial and seasonal-flow watercourses often display characteristics of "wetlands" as an aquatic/wetland interface, or "wetland fringe." Consistent with 33 CFR 328.4(c)(2)), ACOE jurisdiction extends beyond the OHWM to include the adjacent wetland fringe.

To be defined as a wetland by the ACOE, an area must possess all three (3) essential characteristics of a wetland, as defined in the January 1987 Corps of Engineers Wetlands Delineation Manual: (1) hydrophytic vegetation; (2) hydric soils; and (3) wetland hydrology. Hydrophytic vegetation is defined as macrophytic plant life growing in water, or on a substrate that is at least in periodic oxygen deficiency resulting from excessive water. However, the majority of plant species growing in wetlands also grow, to varying degrees, in non-wetland conditions. To aid in the assessment of hydrophytic vegetation, the U.S. Fish and Wildlife Service (USFWS) has published the "National List of Plant Species That Occur In Wetlands," which is based on a review of the scientific literature and has been peer-reviewed by wetland experts and botanists. The list separates plants into five (5) groups, commonly called "wetland indicator species," based on the estimated probability that the area in which a plant species is located is a wetlands. In order of decreasing probability of wetlands, the "wetland indicator species" are:

(1) Obligate wetland indicator status plants (OBL) - greater than 99 percent probability;

(2) Facultative wetland plants (FACW) - between 67 percent and 99 percent probability;

(3) Facultative plants (FAC) - between 34 percent and 66 percent probability;

(4) Facultative upland plants (FACU) - between 1 percent and 33 percent probability; and

(5) Obligate Upland plants (UPL) - less than 1 percent probability.

2.2. Definition of "Waters of the United States"

2.2.1. Waters of the United States

As discussed at 33 CFR 328.3(a)(1), "waters of the United States" are "waters which are currently used, or were used in the past, or may be susceptible to use in interstate or foreign commerce."

2.2.2. "Isolated" Waters of the United States

33 CFR 328.3(a)(3) extends the definition of "waters of the United States" to include "waters" commonly known as "isolated waters of the United States." These include "All other waters such as *intrastate* lakes, rivers, streams (including intermittent streams), mudflats, sandflats, wetlands, sloughs, prairie potholes, wet meadows, playa lakes, or natural ponds, the use, degradation, or destruction of which could affect interstate or foreign commerce including any such waters: (i) Which are or could be used by interstate or foreign travelers for recreational or other purposes; or (ii) From which fish or shellfish are or could be taken and sold in interstate or foreign commerce; or (iii) Which are used or could be used for industrial purpose by industries in interstate commerce."

In addition, the ACOE has stated that "isolated waters of the United States" includes "waters": "which are or would be used as habitat by birds protected by Migratory Bird Treaties; or which are or would be used as habitat by other migratory birds which cross state lines; or which are or would be used as habitat for endangered species; or used to irrigate crops sold in interstate commerce" (51 FR 41217; reconfirmed by Personal Communication, Ms. Elizabeth G. White, ACOE Project Manager in San Diego, November 21, 1994). Subsequent discussions with the ACOE have clarified that the limit of the habitat definition is, if vegetation-based, only that vegetation which creates the habitat which occurs within the OHWM of the channel (Personal Communication, Mr. Bruce Henderson, ACOE Project Manager in Los Angeles, September 14,1995).

3. WATERCOURSES ASSESSMENT

3.1. Methodology

In September of 1994, stereo 1:24000 scale aerial photographs, as well as a 1:6000 scale enlargement of the aerial photographs, of the Project mine and process area were reviewed and all identified ephemeral watercourses indicated on a 1:6000 scale, 5-foot contour interval topographic map produced from aerial photographs by

Chemgold. The map and aerial photographs were then used during a pedestrian survey of the entire mine and process area conducted by botanist Joan Reynolds and ecologist Jaquelyn Picciani, under the direction of registered geologist Richard F. DeLong, in October of 1994 to confirm or revise all of the identified ephemeral watercourses and determine which watercourses were potentially jurisdictional "waters."

All watercourses in the Project mine and process area were assessed during the pedestrian survey. Each watercourse segment was evaluated to determine the presence of an OHWM, using the appropriate jurisdictional criteria (see Section 2.1.1). If an OHWM could be identified, the watercourse segment or tributary was mapped as "waters." Principal watercourses and tributaries identified as "waters" were labeled on the map, while lower order tributary watercourses identified as "waters" were simply marked on the map.

The main channel of each principal watercourse, and some of the principal tributaries, were divided into segments of approximately 1,000 to 2,500 feet, based upon generally common channel dimensions. The depth of each principal watercourse or principal tributary segment, or entire principal tributary, was individually determined in the field by measuring the height of the OHWM above the average bottom of the watercourse channel at the measurement point, taking into consideration the uneven distribution patterns of sediment within the channel. The width of each principal watercourse or principal tributary segment, or entire principal tributary, was determined in the field by measuring the bank-to-bank width of the watercourse channel at the OHWM measurement point, and subtracting the width of any "island" within the bank-to-bank channel which rose above the OHWM. The width and depth of the unlabeled lower order tributary watercourses were estimated in aggregate for all of the lower order tributary watercourses to a principal watercourse or principal tributary.

Data forms were completed for each of the principal watercourses, including principal tributaries. The majority of the principal watercourse segments were also photographed. Vegetation growing along each watercourse was identified and noted on the data forms, and a plant species list of the plants identified during the field investigation was prepared.

In May of 1995, Chemgold proposed an approximately 155-acre expansion of the Project mine and process area to accommodate a proposed 300-foot addition to the southern end of the heap leach pad, and made other adjustments to the western and northwestern boundaries of the mine and process area. At that time, registered geologist Richard F. DeLong reviewed the stereo 1:24000 scale aerial photographs of the Project mine and process area, as well as a 1:6000 scale enlargement of the aerial photographs and the 1:6000 scale, 5-foot contour interval topographic map, to locate

all of the ephemeral water courses within the adjusted Project mine and process area boundary. Mr. DeLong conducted a final field survey in October of 1995 to validate the locations, depths and widths of the ephemeral watercourses recently placed within the Project mine and process area. Mr. DeLong also located and mapped that vegetation within the channel of "waters" below the OHWM within the Project mine and process area which could provide habitat which could be used by protected birds, which, therefore, could make these "waters" "waters of the United States."

3.2. Watercourse Descriptions

Figure 3 is a 5-foot contour topographic map which shows the boundary of the Project mine and process area. Plate A is the same map without topography on which the four (4) principal (blue line) watercourses (labeled as watercourses A, C, D and E), and the 45 principal tributaries (labeled as tributaries AT-1 through AT-11; A&B-T1 through A&B-T4; C-T1 through C-T8; D-T1 through D-T2; E-T1 through E-T11; and C&E-T1 through C&E-T8), identified as "waters" have been mapped and labeled. In addition, all of the numerous lower-order tributary watercourses which have been also identified as "waters" have been mapped (but not labeled) on Plate A.

All of the watercourses identified as "waters" on Plate A are ephemeral conductors of precipitation run-off which are not sustained by either watershed or groundwater sources. There is no evidence that any of these "waters:" are or could be used by interstate or foreign travelers for recreational or other purposes; could provide fish or shellfish which are or could be taken and sold in interstate or foreign commerce; are or could be used for industrial purpose by industries in interstate commerce; or are used to irrigate crops sold in interstate commence. None of the watercourses display evidence of ponding water or soil saturation. Soils within or adjacent to the watercourses do not display low chroma values characteristic of hydric soils. None of the watercourses support riparian vegetation or a prevalent hydrophytic flora.

Data forms completed for each of the principal watercourses, including principal tributaries, are presented in Appendix A. Representative photographs of the principal watercourse segments are presented in Appendix B. A species list of the plants identified during the field investigation is presented in Appendix C.

3.2.1. Watercourse A

The entire reach of Watercourse A, and its mapped tributaries, within the Project mine and process area exhibit an apparent channelized flow regime and perceptible OHWM within each watercourse. Table 1 provides a summary of the length, average OHWM width, and resulting acreage of each reach of the main

channel, principal tributaries, and unlabeled tributaries of Watercourse A within the Project mine and process area.

The main channel of Watercourse A varies in OHWM width from greater than 150 feet (with numerous braided channels, bars, and vegetated islands) to one (1) incised channel of less than a 30-foot OHWM width. The depth of the main channel taken from the OHWM also varies, from 18 inches to 40 inches. Eleven (11) sites within the main channel were measured for width and depth at 1,000- to 1,500-foot intervals (see Appendix A), although only five (5) of these were actually within the Project mine and process area boundary.

The bed of the main channel of Watercourse A is composed of sand, gravel and cobbles with soil particles less than 1 millimeter (mm) deposited in pockets. Ironwood *(Olneya tesota)*, palo verde *(Cercidium floridum)*, cheesebush *(Hymenoclea salsola)*, burrobush *(Ambrosia dumosa)* and brittle-bush *(Encelia farinosa)* grow in areas along the channel banks, bars and islands. Plate B identifies the specific locations of those ironwood and palo verde trees, greater than 5 feet in height, which are rooted within the channel defined by the OHWM which may be used as habitat by migratory birds which cross state lines. There is no evidence (such as burrows, pallets, or nesting sites) that any of the "waters" are used as habitat by the desert tortoise, the only federal listed threatened species within the Project mine and process area.

Table 1: Length, Width and Acreage of Watercourse A and Tributaries Within the Mine and Process Area

Watercourse Designation	Length (ft.)	OHWM Width (ft.)	Acreage (ac.)
Main Channel			
A-M4	1,500	45	1.55
A-M5	1,050	151	3.64
A-M6	1,025	42	0.99
A-M7	1,025	33	0.78
A-M8	775	37	0.66
Main Channel Subtotal:	**5,375**	**N/A**	**7.62**
"A" Tributaries			
A-T4	550	3.5	0.04
A-T5	2,000	5	0.23
A-T6	950	6	0.13
A-T7	175	18	0.07
Unlabeled Tributaries	1,300	average 1.50	0.04
"A" Tributary Subtotal:	**4,975**	**N/A**	**0.51**
"A-T1" Tributary (formerly Watercourse "B")			
A-T1-M1	700	51	0.82
A-T1-M2	1,625	24	0.90
A-T1-M3	1,500	29	1.00
A-T1-M4	1,275	21	0.61
A-T1-M5	1,150	11	0.29
A-T1-M6	900	5	0.10
A-T1-M7	1,250	35	1.00
"A-T1" Tributary Subtotal:	**8,400**	**N/A**	**4.72**
"A&B" Tributaries (formerly Watercourse "B" Tributaries)			
A&B-T1	6,825	16.5	2.59
A&B-T2	1,350	20	0.62
A&B-T3	875	27	0.54
A&B-T4	1,000	9	0.21
Unlabeled Tributaries	7,250	average 1.25	0.21
"A&B" Tributaries Subtotal:	**17,300**	**N/A**	**4.17**
Watercourse Total:	**36,050**	**N/A**	**17.02**

Eleven (11) principal tributaries to Watercourse A are catalogued and mapped (A-T1 through A-T11; see Plate A and Appendix A). Four (4) tributaries to tributary A-T1 of Watercourse A have also been mapped and labeled (as A&B-T1 through A&B-T1) on Plate A and included in Table 1. Numerous unlabeled lower order tributary watercourses are also mapped and accounted for in Table 1.

Tributary A-T1 to Watercourse A was originally mapped in the field as a separate principal watercourse ("Watercourse B;" see Appendix A), but subsequently relabeled as a tributary to Watercourse A as it begins just upstream, and joins Watercourse A immediately downstream, of the Project mine and process area boundary. The channel of this, the largest tributary to Watercourse A (labeled "A-T1"), is very braided in the upstream reaches within the Project mine and process area, with an OHWM channel width of 35 feet and depth of 6 inches taken from the OHWM. The channel becomes more incised downstream, to a minimum width of 5 feet and depth of 5 inches taken from the OHWM. The channel then widens and becomes braided with bars and vegetated islands, and reaches a 51-foot width and 25-inch depth before its confluence with Watercourse A. Seven (7) sites, at 1,000- to 2,000-foot intervals, were measured in tributary A-T1 for width and depth.

The streambed of tributary A-T1 is composed of sand, gravel, and cobbles, with deposition of soil particles less than 1 mm. The channel banks, bars and islands are dominated by ironwood, palo verde, creosote bush, brittle-bush and burrobush.

3.2.2. Watercourse C

The entire reach of Watercourse C, and its mapped tributaries, within the Project mine and process area exhibit an apparent channelized flow regime and perceptible OHWM within each watercourse. Table 2 provides a summary of the length, average OHWM width, and resulting acreage of each reach of the main channel, principal tributaries, and unlabeled tributaries of Watercourse C within the Imperial Project mine and process area.

The main channel of Watercourse C upstream near the northern Project mine and process area boundary is incised and narrow, with a measured OHWM width of 14.5 feet and a depth of 19 inches taken from the OHWM. The channel remains incised until just north of the confluence with Watercourse D. After this confluence, the watercourse broadens into numerous channels, bars, and vegetated islands. The width of Watercourse C downstream near the southern Project mine and process area boundary is 130 feet, with an average depth of 13 inches taken from the OHWM. This segment of the watercourse is divided into five (5) discrete channels, each with varying widths and depths. The adjacent banks of Watercourse C at the southernmost (downstream) end of the reach inside of the Project mine and process area show evidence of sheet erosion and numerous small drainages. Six (6) sites within the main channel were measured for width and depth at 1,500- to 2,500-foot intervals (see Table 2), all of which were within the Project mine and process area.

Table 2: Length, Width and Acreage of Watercourse C and Tributaries Within the Mine and Process Area

Watercourse Designation	Length (ft.)	OHWM Width (ft.)	Acreage (ac.)
Main Channel			
C-M1	925	14.5	0.31
C-M2	1,875	20	0.86
C-M3	1,750	15	0.60
C-M4	1,775	62	2.53
C-M5	2,125	184	8.98
C-M6	1,600	130	4.78
Main Channel Subtotal:	**10,050**	**N/A**	**18.06**
"C" Tributaries			
C-T1	825	6	0.11
C-T2	1,225	6	0.17
C-T3	1,525	6.5	0.23
C-T4	5,400	6.5	0.81
C-T5	1,900	3	0.13
C-T6	400	3	0.03
C-T7	2,675	4	0.25
Unlabeled Tributaries	2,525	average 4.75	0.28
"C" Tributary Subtotal:	**16,475**	**N/A**	**2.01**
Watercourse Total:	**26,525**	**N/A**	**20.07**

The bed of the main channel of Watercourse C is composed of sand, gravel and cobbles, with deposition of soil particles less than 1 mm. Ironwood, palo verde, brittle-bush, desert lavender *(Hyptis emoryi)* and big galleta grass *(Pleuraphis rigida)* grow in areas along the channel banks, bars and islands. Plate B identifies the specific locations of those ironwood and palo verde trees, greater than 5 feet in height, which are rooted within the channel defined by the OHWM which may be used as habitat by migratory birds which cross state lines. There is no evidence (such as burrows, pallets, or nesting sites) that any of the "waters" are used as habitat by the desert tortoise, the only federal listed threatened species within the Project mine and process area.

Eight (8) principal tributaries to Watercourse C are catalogued and mapped (C-T1 through C-T8; see Plate A and Appendix A), of which seven (7) are at least partially located within the boundaries of the Project mine and process area. Numerous unlabeled lower order tributary watercourses are also mapped and accounted for in Table 2.

3.2.3. Watercourse D

The entire reach of Watercourse D, and its mapped tributaries, within the Project mine and process area exhibit an apparent channelized flow regime and perceptible OHWM within each watercourse. Table 3 provides a summary of the length, average OHWM width, and resulting acreage of each reach of the main channel, principal tributaries, and unlabeled tributaries of Watercourse D within the Project mine and process area.

Table 3: Length, Width and Acreage of Watercourse D and Tributaries Within the Mine and Process Area

Watercourse Designation	Length (ft.)	OHWM Width (ft.)	Acreage (ac.)
Main Channel			
D-M1	875	70	1.41
D-M2	1,300	81	2.42
D-M3	1,125	54	1.39
D-M4	850	64	1.25
Main Channel Subtotal:	**4,150**	**N/A**	**6.47**
"D" Tributaries			
D-T1	1,250	15	0.43
D-T2	700	3.5	0.06
Unlabeled Tributaries	2,500	average 4.5	0.26
"D" Tributaries Subtotal:	**4,450**	**N/A**	**0.75**
Watercourse Total:	**8,600**	**N/A**	**7.22**

The entire length of the main channel of Watercourse D is braided with channels, bars and islands from the northern boundary of the Project mine and process area to the confluence of Watercourse D with Watercourse C. The main watercourse channel varies from a total OHWM width of 54 feet and 16.5-inch depth in the upstream (north) end of the Project mine and process area to a 64-foot width and 9-inch depth at the intersection with Watercourse C. Four (4) sites within the main channel were measured for width and depth at 1,000- to 2,000-foot intervals (see Table 3), all of which were within the Project mine and process area.

The bed of the main channel of Watercourse D is composed of sand, gravel and cobbles with soil sediment particles less than 1 mm deposited in pockets. Ironwood, brittle-bush, big galleta grass, and Anderson thornbush *(Lycium andersonii)* grow in areas along the channel banks, bars and islands. Plate B identifies the specific locations of those ironwood and palo verde trees, greater than 5 feet in height, which are rooted within the channel defined by the OHWM which may be used as habitat by migratory birds which cross state lines. There is

no evidence (such as burrows, pallets, or nesting sites) that any of the "waters" are used as habitat by the desert tortoise, the only federal listed threatened species within the Project mine and process area.

Two (2) principal tributaries to Watercourse D were catalogued and mapped (D-T1 and D-T2; see Plate A and Appendix A), both of which are at least partially located within the boundaries of the Project mine and process area. A few unlabeled lower order tributary watercourses are also mapped and accounted for in Table 3.

3.2.4. Watercourse E

The entire reach of Watercourse E, and its mapped tributaries, within the Project mine and process area exhibit an apparent channelized flow regime and perceptible OHWM within each watercourse. Table 4 provides a summary of the length, average OHWM width, and resulting acreage of each reach of the main channel, principal tributaries, and unlabeled tributaries of Watercourse E within the Project mine and process area.

The main channel of Watercourse E upstream near the northern Project mine and process area boundary is incised and narrow, with a measured OHWM width of 8 feet and depth of 8 inches taken from the OHWM. The channel remains incised until the confluence with tributary E-T1, after which the main channel becomes braided with bars and vegetated islands. The main channel of Watercourse E broadens to a measured OHWM width of 19 feet and depth of 7 inches taken from the OHWM near the middle of its course, then narrows again downstream to a measured OHWM width of 9 feet and depth of 7 inches taken from the OHWM. Downstream near the southern Project mine and process area boundary the watercourse widens to a 36-foot width and a 10-inch depth, with braided channels, bars and islands. Eleven (11) sites within the main channel were measured for width and depth at 1,500- to 2,500-foot intervals (see Appendix A and Table 4), of which seven (7) were within the Project mine and process area.

Table 4: Length, Width and Acreage of Watercourse E and Tributaries Within the Mine and Process Area

Watercourse Designation	Length (ft.)	OHWM Width (ft.)	Acreage (ac.)
Main Channel			
E-M1	1,350	8	0.25
E-M2	1,225	7	0.20
E-M3	1,075	16	0.39
E-M4	350	19	0.15
E-M5	650	9	0.13
E-M6	1,575	18	0.65
E-M7	950	36	0.79
Main Channel Subtotal:	**7,175**	**N/A**	**2.56**
"E" Tributaries			
E-T1	1,525	5	0.18
E-T2	775	5	0.09
E-T3	1,325	4	0.12
E-T4	850	3	0.06
E-T5	1,400	2	0.06
E-T6	950	2.5	0.05
E-T7	875	9	0.18
E-T8	3,350	25	1.92
E-T9	1,575	2	0.07
E-T10	375	2	0.02
E-T11	875	2.5	0.05
Unlabeled E Tributaries	10,625	average 3.5	0.85
"E" Tributaries Subtotal:	**24,500**	**N/A**	**3.65**
"C&E" Tributaries			
C&E-T1	875	2.5	0.05
C&E-T2	1,300	2	0.06
C&E-T3	1,775	3	0.12
C&E-T4	1,875	2.5	0.11
C&E-T5	1,575	2	0.07
C&E-T6	3,525	16	1.29
C&E-T7	1,875	18	0.77
C&E-T8	3,850	27.5	2.43
Unlabeled C&E Tributaries	14,500	average 2	0.67
"C&E" Tributaries Subtotal:	**31,150**	**N/A**	**5.57**
Watercourse Total:	**62,825**	**N/A**	**11.78**

The bed of the main channel of Watercourse E is composed of sand, gravel, and cobbles, with soil sediment deposition of particles less than 1 mm in size.

Ironwood, palo verde, brittle-bush, burrobush, and big galleta grass grow in areas along the channel banks, bars and islands. Plate B identifies the specific locations of those ironwood and palo verde trees, greater than 5 feet in height, which are rooted within the channel defined by the OHWM which may be used as habitat by migratory birds which cross state lines. There is no evidence (such as burrows, pallets, or nesting sites) that any of the "waters" are used as habitat by the desert tortoise, the only federal listed threatened species within the Project mine and process area.

Eleven (11) principal tributaries to Watercourse E are catalogued and mapped (E-T1 through E-T11; see Plate A and Appendix A). Eight (8) additional tributaries to Watercourse E which lie between Watercourse C and Watercourse E (C&E-T1 through C&E-T8) have also been labeled and mapped on Plate A and accounted for in Table 4. Numerous unlabeled lower order tributary watercourses are also mapped and included in Table 4.

4. Determination of ACOE Jurisdiction

4.1. Wetlands Assessment

As indicated in Section 3.2, none of the watercourses display evidence of ponding water or soil saturation; display low chroma values characteristic of hydric soils; or support riparian vegetation or a prevalent hydrophytic flora. Each plant species occurring within the Project mine and process area was identified and its indicator status determined (Appendix C). No OBL, FACW, or FAC plant species indicative of wetlands were identified within the Project mine and process area.

4.2. Determination of "Waters"

Based on the field observations described above, including the presence of perceptible OHWM within each watercourse (i.e., bank scour marks, bank lines, shelving, changes in soil character, damaged terrestrial vegetation or presence of litter and debris) and an apparent channelized flow regime (i.e., a measurable bank-to-bank width) versus an apparent non-channelized, sheet-flow regime (i.e., no defined OHWM or embankments), and the definitions discussed in Section 2, the entire reaches of Watercourses A, C, D and E, and their tributaries mapped within the Project mine and process area, as presented on Plate A, exhibit the site-specific physical characteristics of "waters".

4.3. Determination of Jurisdictional "Waters of the United States"

None of the "waters" mapped within the Project mine and process area meet the definition of "waters of the United States" found at 33 CFR 328.3(a)(1), since there is no evidence that these are "waters which are currently used, or were used in the past, or may be susceptible to use in interstate or foreign commerce" (see Section 3.2). However, portions of these "waters" do appear to conform to the expanded definition of "isolated waters of the United States" found in 51 FR 41217, since limited reaches directly support vegetation which could be utilized as habitat by migratory birds. Plate B identifies the specific locations of those ironwood and palo verde trees, greater than 5 feet in height, which are rooted within the channel defined by the OHWM which may be used as habitat by migratory birds which cross state lines. Plate B also highlights those reaches of the watercourses or tributary channels which have been identified as "waters of the United States" by inclusion of the watercourse containing the jurisdictional vegetation to the points upstream and downstream to the confluence with the next "waters" tributary. Table 5 presents a summary of the total length, width and acreage for all reaches of the principal watercourses (A, C, D and E) and their tributaries within the Project mine and process area which have been classified as waters of the United States.

5. AFFECTS ASSESSMENT

The proposed Imperial Project would consist of the development of the following components, each of which could result in the dredging or filling of one or more watercourse or tributary reaches identified as "waters of the United States" in Section 5 and Plate B:

- Three (3) open pits, identified as the West Pit, East Pit and Singer Pit;
- One (1) Mineralized Potential Area, co-joining the three (3) separate pits;
- Four (4) waste rock stockpiles;
- Up to four (4) soil stockpile sites.
- One (1) administration office and maintenance facility area;
- One (1) heap leach facility;
- One (1) precious metal recovery plant and other ancillary facilities;
- One (1) power substation and associated new and rebuilt 92 kV transmission line, or on-site diesel power generators.

- A system of roads internal to the Project site which would connect the various facility components.

Table 5: Summary of Jurisdictional "Waters of the United States" in the Mine and Process Area

Watercourse Designation	Reach Length (ft.)	OHWM Width (ft.)	Acreage (ac.)
Main Channels			
Watercourse C	900	14.5	0.30
	975	20	0.45
	575	62	0.82
	2,125	184	8.98
	975	130	2.91
Main Channel Totals:	**5,550**	**N/A**	**13.46**
Watercourse D	900	70	1.45
	1,025	81	1.91
	650	54	0.81
Main Channel Totals:	**2,575**	**N/A**	**4.17**
Watercourse E	575	8	0.11
	425	7	0.07
	475	16	0.17
	800	18	0.33
	950	36	0.79
Main Channel Totals:	**3,225**	**N/A**	**1.47**
Tributaries			
A-T1	550	51	0.64
	1,625	24	0.90
	1,100	29	0.73
Unlabeled "A" Tributaries	175	average 1.50	0.01
A&B-T1	600	16.5	0.23
Unlabeled "A&B" Tributaries	1,575	average 1.25	0.05
C-T4	1,225	6.5	0.18
C-T7	850	4	0.08
Tributary Totals:	**7,700**	**N/A**	**2.82**
Total:	**19,050**	**N/A**	**21.92**

Plate C shows the locations of all of the Project facilities which are proposed within the mine and process area which could result in the dredging or filling of one or more watercourse or tributary reaches identified as "waters of the United States." A summary of the potential dredge or fill which may occur to "waters of the United States" as a result of construction of the Project facilities presented on Plate C are presented below, aggregated by major Project component:

- Segments of Watercourse A and its tributaries, including A-T1, A-T4 through A-T6, and A&B-T2 through A&B-T4, and Watercourse C and its tributary C-T1, would be

dredged and/or filled due to the construction of the West Pit and adjacent waste rock stockpiles in the northwest corner of the Project mine and process area;

- The waste rock stockpile proposed for construction in the southwest portion of the Project mine and process area would fill several tributaries to Watercourse A, including A-T1 and A&B-T1, and several tributaries to Watercourse C, including C-T5 through C-T7.

- Segments of Watercourses C, D and E, and tributaries C-T3, D-T2, E-T3 through E-T7, and E-T9 through E-T11, would be dredged and/or filled due to the construction of the East Pit and adjacent waste rock stockpile in the eastern portion of the Project mine and process area;

- Construction of the Singer Pit and the soil stockpile area located in the middle of the northern portion of the Project mine and process area would dredge or fill tributaries C-T2 and C-T3, and D-T1; and

- The leach pad, ponds and soil stockpile located in the middle and southern portion of the Project mine and process area would directly dredge and/or fill a short segment of tributary C-T4 and the entire reaches of tributaries to Watercourse E, including tributaries C&E-T1 through C&E-T8, which are "waters of the United States."

Table 6 summarizes the total number of lineal feet (length) of watercourse or tributary "waters of the United States" which will be dredged or filled by the Project; the width of that dredged or filled reach; and the area of each reach of "waters of the United States" affected, which are calculated by multiplying the length of the reach by the average width and converting the resulting number of square feet to acres. The result is an "affect" to a combined total of 8.58 acres of "waters of the United States."

6. REFERENCES

Bamberg, S.A., and I.E. Hanne, 1995: Vegetation Baseline Survey - Imperial Project, Imperial County, California. Report to Chemgold, Inc., Imperial Project, Bamberg Associates, August 1995.

GSi/Water, 1993: Preliminary Assessment of Available Groundwater, Indian Rose Project, Imperial County, California, July 1, 1993.

Rado, T., 1995: Biological Survey Report, Chemgold Imperial Project, California, May 1995.

Table 6: Calculation of Jurisdictional "Waters of the United States" Affected by the Imperial Project

Watercourse Designation	Reach Length (ft.)	OHWM Width (ft.)	Acreage (ac.)
Main Channels			
Watercourse C	900	14.5	0.30
	975	20	0.45
	0	62	0.00
	0	184	0.00
	0	130	0.00
Main Channel Totals:	**1,875**	**N/A**	**0.75**
Watercourse D	550	70	0.88
	1,025	81	1.91
	650	54	0.81
Main Channel Totals:	**2,225**	**N/A**	**3.60**
Watercourse E	575	8	0.11
	425	7	0.07
	475	16	0.17
	800	18	0.33
	950	36	0.79
Main Channel Totals:	**3,225**	**N/A**	**1.47**
Tributaries			
A-T1	550	51	0.64
	1,625	24	0.90
	1,100	29	0.73
Unlabeled "A" Tributaries	0	average 1.50	0.00
A&B-T1	600	16.5	0.23
Unlabeled "A&B" Tributaries	1,575	average 1.25	0.05
C-T4	1,225	6.5	0.18
C-T7	300	4	0.03
Tributary Totals:	**6,975**	**N/A**	**2.76**
Total:	**14,300**	**N/A**	**8.58**

APPENDIX C
WATERCOURSE PLANT SPECIES LIST

Common Name	Scientific Name	Watercourse	Indicator Status[1]
Cat-claw	*Acacia greggii*	A-T1,C,E	FACU
Burrobrush	*Ambrosia dumosa*	A,A-T1,C,D,E	N/I - UPL
Fairy duster	*Calliandra eriophylla*	A,A-T1,C,D,E	N/I - UPL
Palo verde	*Cercidium floridum*	A,T-1,C,D,E,	N/I - UPL
Pincushion flower	*Chaenactis sp.*	A-T1	N/I - UPL
Rattlesnake spurge	*Chamaesyce albomarginata*	A,A-T1,C,D,E	N/I - UPL
Rigid spiney-herb	*Chorizanthe rigida*	A-T1	N/I - UPL
Forget-me-not	*Cryptantha sp.*	A-T1,D	N/I - UPL
Dodder	*Cuscuta sp.*	C	N/I - UPL
Brittle-bush	*Encelia farinosa*	A,A-T1,C,D,E	N/I - UPL
Desert trumpet	*Eriogonum inflatum*	E	N/I - UPL
Fluffgrass	*Erioneuron pulchella*	A	N/I - UPL
California barrel cactus	*Ferocactus cylindriceus*	C,D,E	N/I - UPL
Ocotillo	*Fouquieria splendens*	A-T1,C,D,E	N/I - UPL
Matchweed	*Gutierrezia sarothrae*	C,E	N/I - UPL
Yellow felt-plant	*Horsfordia newberryi*	A	N/I - UPL
Cheesebush	*Hymenoclea salsola*	A-T1,C,E	N/I - UPL
Desert lavender	*Hyptis emoryi*	A,A-T1,C,D,E	N/I - UPL
Purple heather	*Krameria erecta*	C,D,E	N/I - UPL
Creosote bush	*Larrea tridentata*	A,A-T1,C,D,E	N/I - UPL
Peppergrass	*Lepidium lasiocarpum*	A-T1	N/I - UPL
Anderson thornbush	*Lycium andersonii*	A,A-T1,C,D,E	N/I - UPL
Corkseed cactus	*Mammalaria tetrancistra*	A,	N/I - UPL
Desert tobacco	*Nicotiana obtusifolia*	A,A-T1	N/I - UPL
Desert ironwood	*Olneya tesota*	A,A-T1,C,D,E	N/I - UPL
Golden cholla	*Opuntia acanthicarpa*	A,A-T1,C,D,E	N/I - UPL
Beavertail cactus	*Opuntia basilaris*	A,A-T1,C,D,E	N/I - UPL
Bigelow cholla	*Opuntia bigelovii*	A,A-T1,E	N/I - UPL
Big galleta grass	*Pleuraphis rigida*	A,C,D,E	N/I - UPL
Jojoba	*Simmondsia californica*	A-T1,C,D,	N/I - UPL

---

[1] USFWS, 1988; Biological Report, National List of Plane Species that Occur in Wetlands: Nevada.

N/I - Not listed as a national indicator, assumed to be obligate upland plants (OBL).

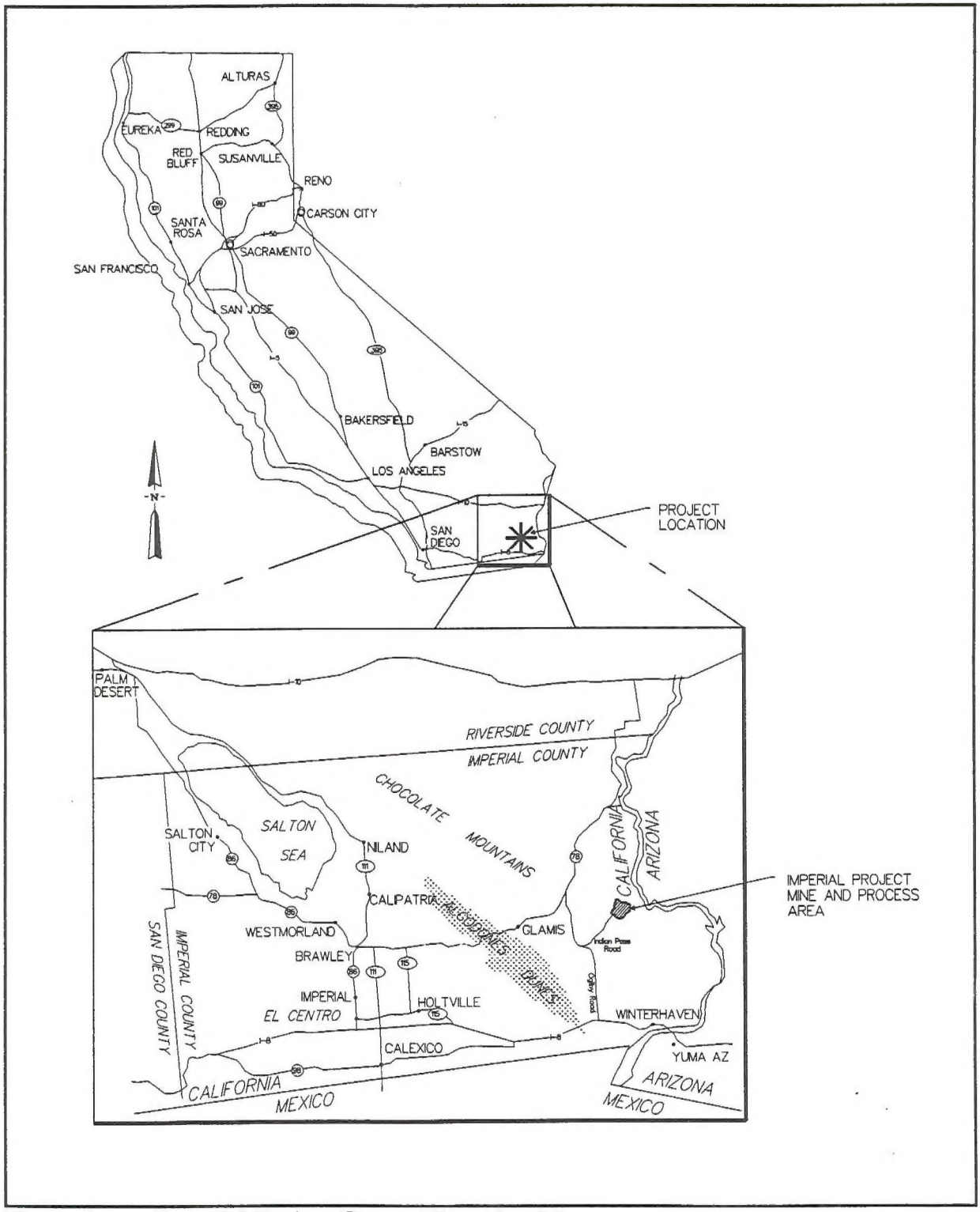


Figure 1: Imperial Project General Location Map

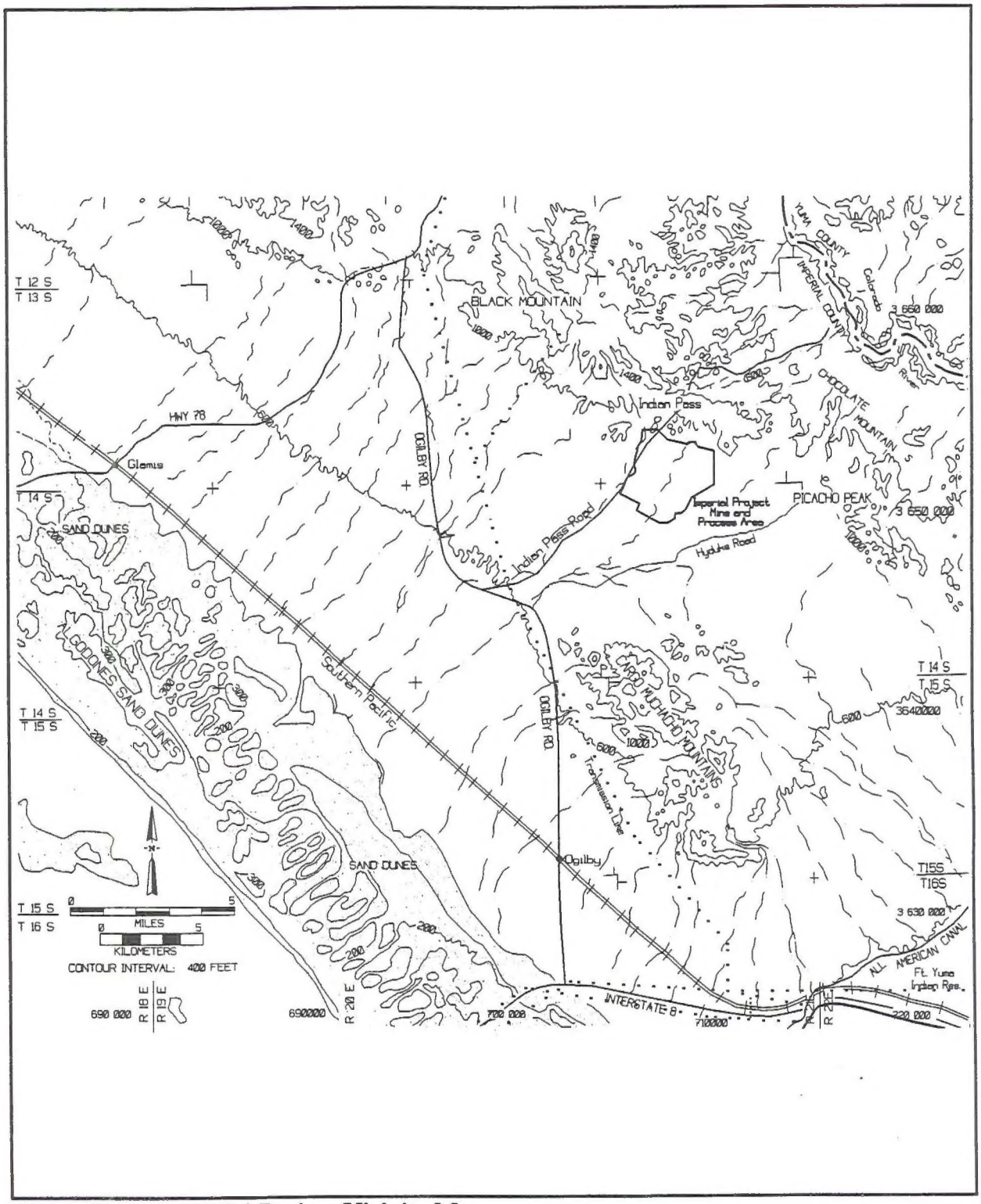


Figure 2: Imperial Project Vicinity Map

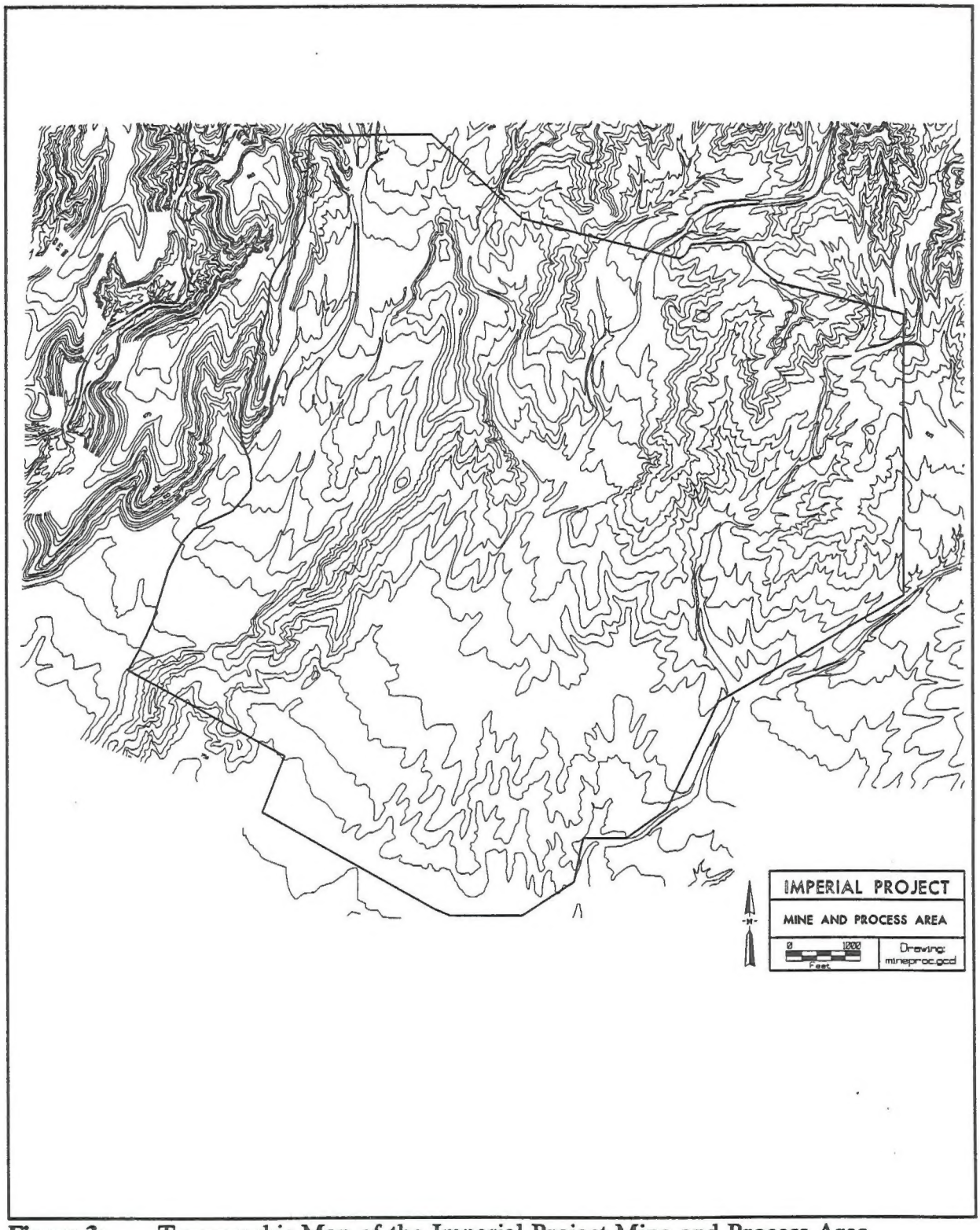


Figure 3: Topographic Map of the Imperial Project Mine and Process Area

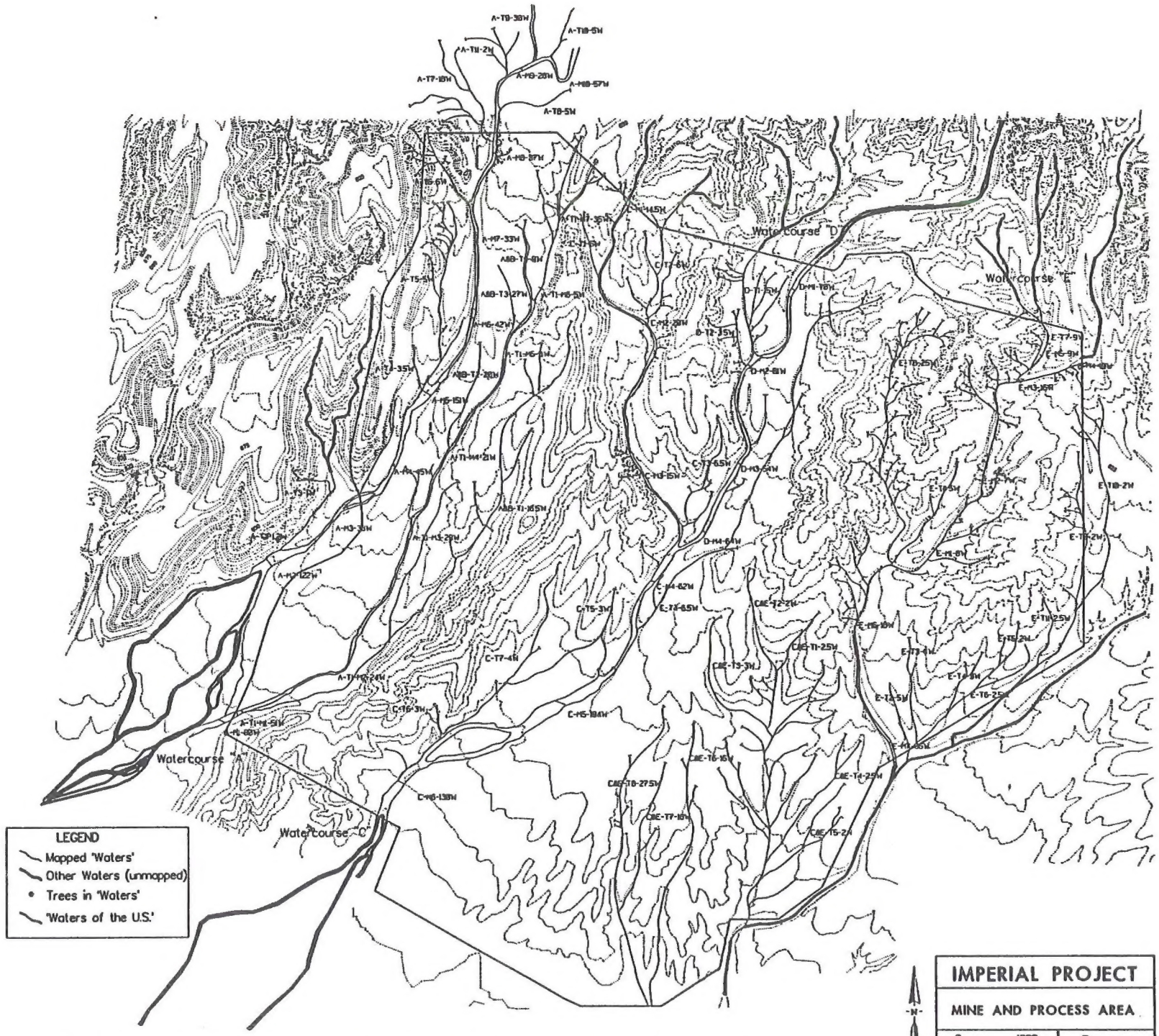


Plate No. 1: Delineation Map of 'Waters' Within the Imperial Project Mine and Process Area

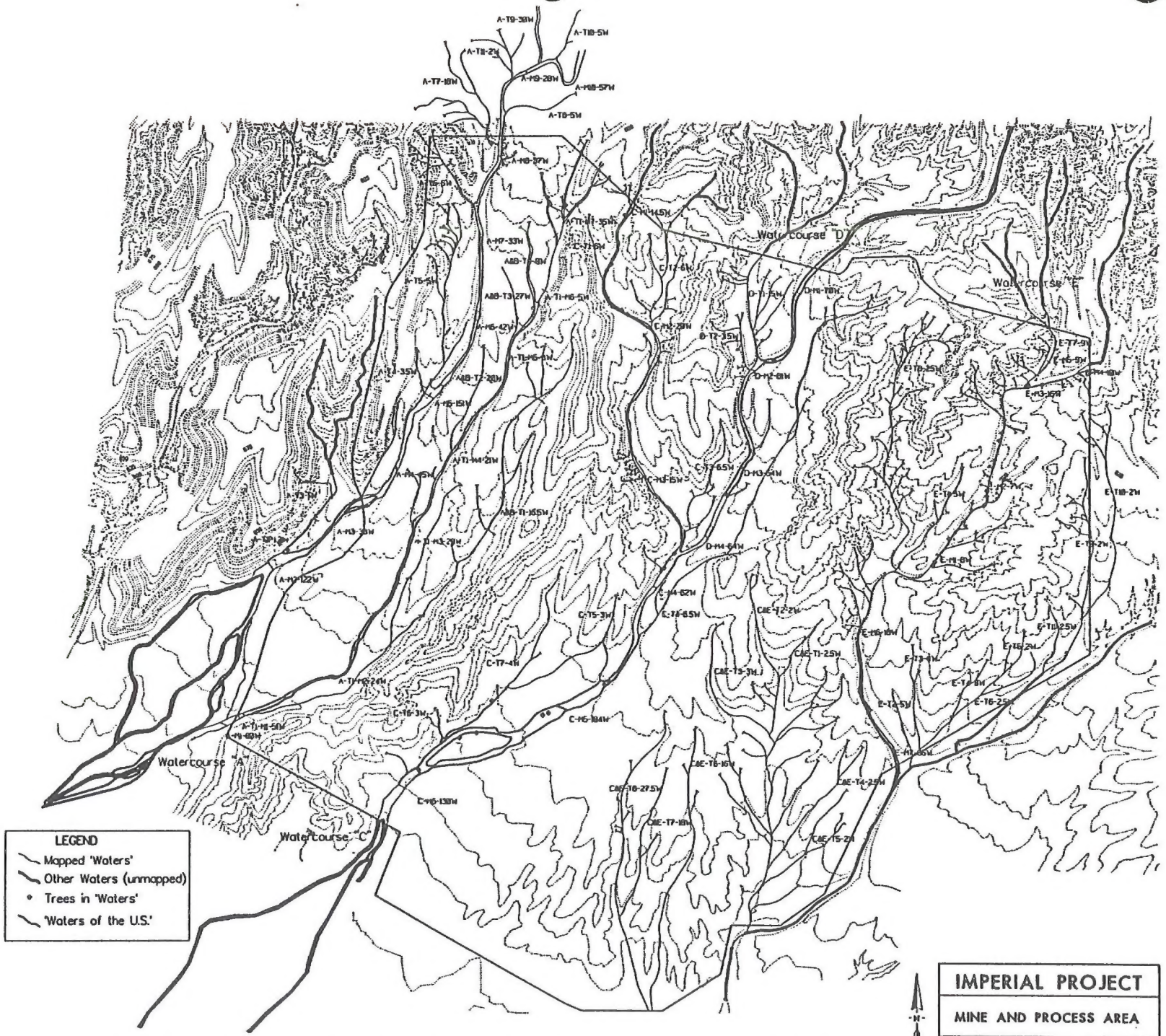


Plate No. 2: Map of 'Waters of the United States' Within the Imperial Project Mine and Process Area Showing Trees Within the OHWM Channels

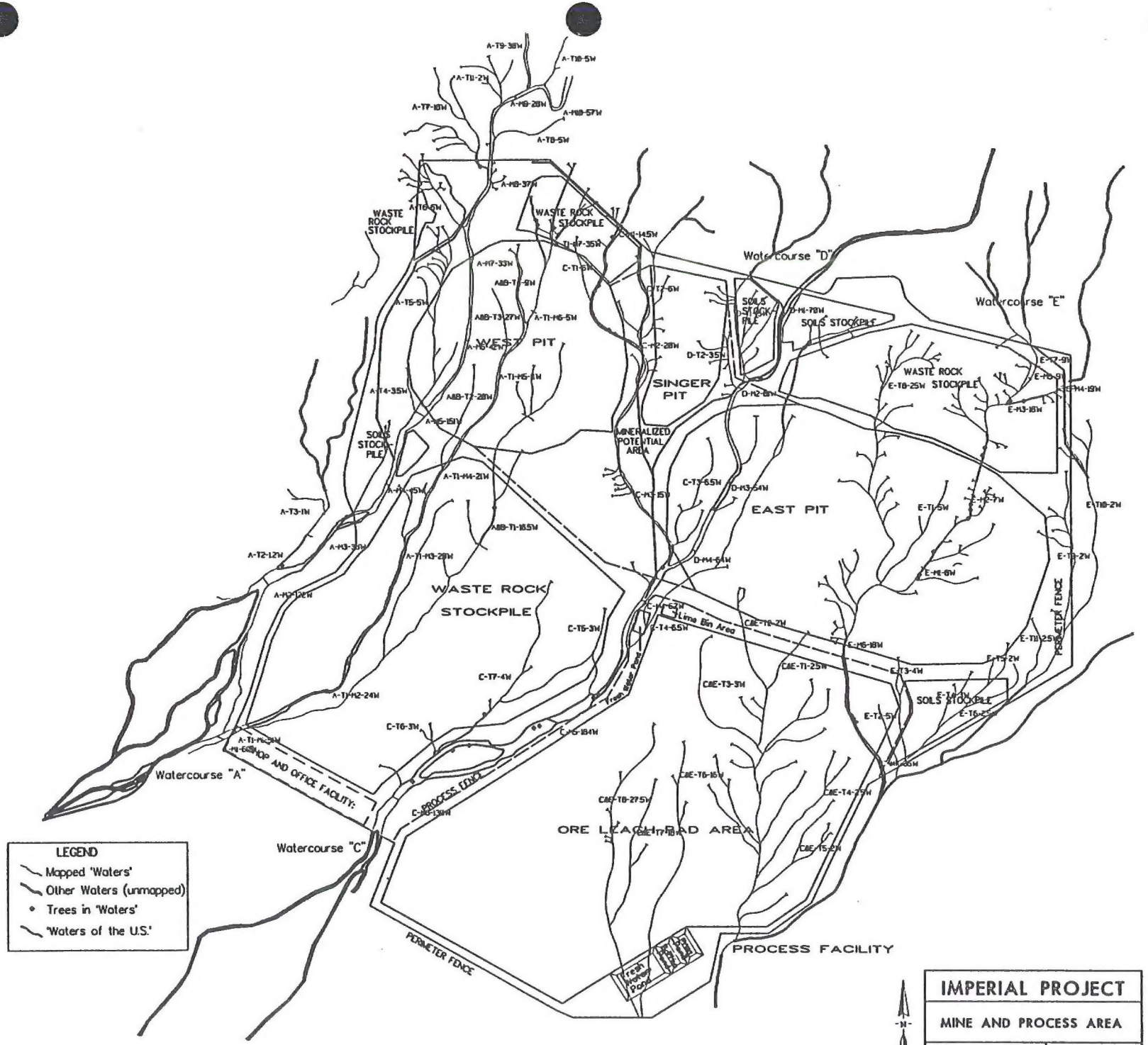


Plate No. 3: Map of 'Waters of the United States' Showing Those Proposed Project Facilities Which May Result in Dredge or Fill to Jurisdictional 'Waters of the United States'

APPENDIX A

FIELD DATA FORMS

PROJECT IMPERIAL -- CHEMGOLD INC.

WATERS OF THE U.S. FIELD DATA FORM

Date: 10/7/94
Data Form Number: #1 WATERS "A"
Habitat Type: DRY WASH - EPHEMERAL / IRONWOOD / PALO VERDE - DESERT SCRUB Slope: 0-5%
Waters of US Present: YES Aspect: SOUTHERLY
OHWM Present: YES
Bank Lines: PRESENT IN SCATTERED LOCATIONS
Shelving: PRESENT ON SOME BANKS
Veg. Break: SOME EVIDENCE OF WATER FLOW DAMAGE + VEG IS CHARACT. OF DRY WASHES
Litter/Debris: IN POCKETS, SNAGGED AROUND PLANTS. SMALL BRUSH. ROCKS
Surface Scouring:

Channel Description: CHANNEL CHANGES THROUT ITS LENGTH. IN THE NORTHERN PORTION OF ITS SOURCE IE. CHANNELIZED W/ INCISED BANKS NEAR THE PROPERTY BOUNDARY TO MEANDERING VERY WIDE AND BRAIDED AS IT TRAVELS SOUTH

Width and Depth Measured at 1000 - 1500 FT Intervals. 10 MEASUREMENTS TAKEN AND PHOTOS OF WASH A. SEE TABLE "A" FOR RESULTS
Soil Particle Size(s): SCOURED AREAS WITH FINDS OF <1 MM AND LARGER GRAVELS AND COBBLES UP TO >5 cm.
Direction of Flow: SOUTHERLY

Ephemeral ✓ Perennial _____

Number of Tributaries 11.
Description:

A-T1 — TRIB #A-T1 (= WATERS #B-1) 25 inches depth; 5 ft wide, defined channel w/ sandy cobbled bottom, shelving on steep banks, incised channel.
A-T2 — Depth average 6 inches; width 12-16 inches, shelving lies on banks. Channelization. Soil finds deposited <1 mm. Cobbled basalt flow on surface
A-T3 — Flows into Trib #2-T2 - Average depth 4 inches, av width 10-12 inches, Channels fade in upper reaches. Some shelving and deposition of finds <1 mm.
A-T4 — Av. width 3.5 ft; Av. depth 20 inches, Channelization, no shelves, no veg. debris.
A-T5 — UPPER REACHES 3-4 ft wide; 6-20 inches deep, channels fade in + out w/ short tributaries Lower reach near confluence w/ A becomes braided. No veg debris. Deposition of finds <1 mm.
A-T6 — Lots of feeders w/ some channels feeding into Trib A-T6 - some is topo relief. Lower on trib: shelving; cobbles: finds deposited <1 mm; veg. debris deposition. AV. DEPTH 18" AV. WIDTH 6'
A-T7 — Average Depth of 15 inches, average width is approx. 18 feet. (6"-24" depth, 6'-30' width) some feeder tribs also channelized w/ topo relief/ sheet erosion at headwaters. Bottom of trib A-T was sandy gravel bottom; cobbles. Islands of veg in braided channels.
A-T8 — Average depth 12"; average Width 5 ft. Channeled w/ shelving of OHWMs and a gravel bottom w/ cobbles, shelving, bank scour, drift wood / Debris
A-T9 — Average Depth 24-36 inches; Average width 30 ft. Sandy bottom w/ Channeled banks/ and cobbles in the watercourse bed. some veg debris deposited on roots, rocks, shrubs
A-T10 — Average width 5 ft; Average Depth 2 ft. Deep incised channel with scouring, finds depo. of <1 mm particles; shelving on channeled banks; Water staining.
A-T11 — Average Width 2 ft. Average depth 10 inches. Channeled with shelving on steep banks Many tribs feeding into A-T11, originating in topo relief - refer to map.

J.R. & J.P.

IMPERIAL PROJECT
WATERCOURSE SURVEY

Date: 10/7/94

Watercourse #: "A" - MEASUREMENTS # M1 → M10 - TAKEN AT 1,000 - 1500 FT INTERVALS

Sample Number	Topo Type1	Defined Bed/Bank	OHWM	Shelves	Veg Break	Scour Bed Bank	Other	Waters of US	Est. Depth INCHES	Est. Width FEET
A-M1	C	Y	Y	Y	Y	Y	TRIB TO WASH "A" VEG. DEBRIS	N	18"	ENTIRE 60'
A-M2	C	BRAIDED CHANNELS-E! W/BANKS Y	Y	Y	Y	Y	BRAIDED CHANNELS VEG. DEBRIS	N	40"	ENTIRE 122'
A-M3	C	Y	Y	Y	N	Y	VEG. DEBRIS DEPOSITION	Y	31"	33'
A-M4	C	2 CHANNELS Y	Y	Y	N	Y	VEG DEBRIS DEPOS.	N	18"	45'
A-M5	C	ISLANDS IN BETWEEN CHANNELS Y	Y	Y	Y	Y	VEG. ISLANDS VEG DEBRIS	N	31"	151'
A-M6	C	CONFINED CHANNEL Y	Y	Y	Y	Y	VEG DEBRIS	N	35"	42'
A-M7	C	Y	Y	N	N	Y	FINDS 2 VEG DEBRIS	N	33"	33'
A-M8	C	CONFINED CHANNEL Y	Y	Y	Y	Y	VEG. DEBRIS	N	37"	37'
A-M9	C	CONFINED CHANNEL Y	Y	N	N	Y	VEG DEBRIS	N	29"	28'
A-M10	C	Y	Y	Y	N	Y	VEG. DEBRIS FINDS 4	N	38"	57'

1 C-CHANNEL, S-SWALE, D-GENERIC DRAINAGE

NOTES: WATERCOURSE NEAR NORTHERN PROJECT BOUNDARY WIDENS, FLOWS SOUTH AND BECOMES MORE INCISED TO NEAR SOUTHERN PROJECT BOUNDARY WHERE WIDENS AGAIN - VERY BRAIDED, DEPOSITION OF SANDS & GRAVEL ILLUSTRATE FLOW PATTERNS. WASH BED SANDY W/ GRAVELS AND LARGE COBBLES INTESPERSED.

WATERS "A" ENTIRE REACH (LENGTH) =~ 8500 FT

* MEASURE A-T1 = B-M6

R: J.P.

IMPERIAL PROJECT
WATERCOURSE SURVEY

Date: 10/7/94
Watercourse #: "A" - TRIBUTARIES #'S A-T1 → A-T11

	Sample Number	Topo Type1	Defined Bed/Bank	OHWM	Shelves	Veg Break	Scour Bed	Other	Waters of US	Est. AV Depth INCHES	Est. AV Width FEET
*	A-T1	C	SHARD EBANK Y	Y	Y	N	Y	VEG DEBRIS DEPOSITS	N	25"	5 FT
	A-T2	C	Y	Y	Y	N	Y		Y	6"	1'2
	A-T3	(D → C)	Y	Y	Y	N	Y	CHANNELS FADE UPPER REACHES	N	4"	1'
	A-T4	C	BANK LINES Y	Y	N	N	Y		N	20"	3.5'
	A-T5	(S → C)	BRAIDED CHANNELS Y	Y	Y	N	Y	BRAIDED CHANNELS	N	13"	5'
	A-T6	(S → C)	BRAIDED CHANNELS Y	Y	Y	N	Y	VEG DEBRIS + FINES Clay DEPOSITS	N	15"	6'
	A-T7	C	BRAIDED CHANNELS Y	Y	Y	Y	Y	VEG. ISLANDS + VEG DEBRIS DEPOS.	Y	15"	18'
	A-T8	C	Y	Y	Y	N	Y		N	12"	5'
	A-T9	C	BRAIDED CHANNELS Y	Y	Y	N	Y	VEG. DEBRIS DEPOS.	N	30"	30'
	A-T10	C	INCISED CHANNEL Y	Y	Y	N	Y	VEG DEBRIS & FINES Clay DEPOSITED	N	24"	5'
	A-T11	D → C	INCISED CHANNEL Y	Y	Y	N	Y		N	10"	2'

#1 C-CHANNEL, S-SWALE, D-GENERIC DRAINAGE

NOTES: D → WATERCOURSE STARTS AS A GEN. DRAINAGE & BECOMES CHANNELIZED.
S → " " " " SWALE " " " .

"A" TRIBUTARIES CUMMULATIVE LENGTHS = 17,250 FT.

#1 WATERS "A"

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

A-#1 measurement Photo #2 downstream ✓ #3 upstream ✓

Project/Site: Imperial
Applicant/Owner: Chemgold
Investigator: JP + JK

Date: 10/7/94
County: Imperial
State: CA

Do Normal Circumstances exist on the site? (Yes) No
Is the site significantly disturbed (Atypical Situation)? Yes (No)
Is the area a potential Problem Area? Yes (No)
(If needed, explain on reverse.)

Community ID:
Transect ID: "A"
Plot ID: 1 of 2

VEGETATION

upland "island"

Dominant Plant Species	Stratum	Indicator
*1. Cercidium floridum		
*2. Hymenoclea salsola		
3. Larrea tridentata		
*4. Olneya tesota		
*5. Hyptis emoryi		
6. Lycium andersonii		
*7. Encelia farinosa		
8. Opuntia acanthocarpa		
9. Larrea tridentata		
10. Opuntia basilaris		
11. Opuntia bigelovii		
12. Horsfordia Newberryi (yellow bittplant)		
13. Mammalaria tetrancistra		
14. Erioneuron pulchellum		
15. Chamaesyce albomarginata		
*16. Ambrosia dumosa		
Nicotiana trigonophylla		

Percent of Dominant Species that are OBL, FACW or FAC (excluding FAC-).

Remarks: * DOMINANTS

HYDROLOGY

___ Recorded Data (Describe in Remarks):
- ___ Stream, Lake, or Tide Gauge
- ✓ Aerial Photographs
- ___ Other

___ No Recorded Data Available

Field Observations:

Depth of Surface Water: _____ (in.)

Depth to Free Water in Pit: _____ (in.)

Depth to Saturated Soil: _____ (in.)

Wetland Hydrology Indicators:

Primary Indicators:
- ___ Inundated
- ___ Saturated in Upper 12 Inches
- ✓ Water Marks
- ✓ Drift Lines
- ✓ Sediment Deposits
- ___ Drainage Patterns in Wetlands

Secondary Indicators (2 or more required):
- ___ Oxidized Root Channels in Upper 12 Inches
- ___ Water-Stained Leaves
- ___ Local Soil Survey Data
- ___ FAC-Neutral Test
- ___ Other (Explain in Remarks)

Remarks: → Debris. Photo #4 A#2
#3 Map only kinda. Shelving, narrow channel 6-12" deep. Trib #3 to "A"
gravelly substrate

A #3 measurement Photo #5 downstream ✓ A#5 Photos #9 downstream
#6 upstream w/debris ✓ #10 upstream - main channel } braided area
" #4 " #7 downstream
#8 upstream ✓

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

#1 WATERS "A" CONTINUED

Project/Site: Imperial	Date: 10/7/94
Applicant/Owner: Chemgold	County: Imperial
Investigator: JR + JP	State: CA
Do Normal Circumstances exist on the site? (Yes) No	Community ID:
Is the site significantly disturbed (Atypical Situation)? Yes No	Transect ID: "A"
Is the area a potential Problem Area? Yes No	Plot ID: 2 of 2
(If needed, explain on reverse.)	

VEGETATION

Dominant Plant Species	Stratum	Indicator
1. A Trib 8 Callandra eriophylla		
2. A Trib 6 - Linear leaved w/ turpenes		
3. *Ambrosia dumosa		
4. Fouquiera splendens		
5. *Baccharis sarothroides		
6. Olneya tesota		
7. A T5 - Olneya tesota; - Larrea tridentata		
8. Encelia farinosa; Fouquiera splendens		

Dominant Plant Species	Stratum	Indicator
9. AT5 cont'd *Hilaria rigida		
10. *Ambrosia dumosa		
11. *Cercidium floridum		
12.		
13.		
14.		
15.		
16.		

Percent of Dominant Species that are OBL, FACW or FAC (excluding FAC-).

Remarks: A Trib 8 - 5' wide Photo #19 upstream, 20 downstream } Waters Shelving Channel gravel/cobble substrate
measured 1' deep

*DOMINANTS

last photo on roll 1 ✓

A Trib 5 (Photo #1 2nd roll ✓)

HYDROLOGY

___ Recorded Data (Describe in Remarks):
- ___ Stream, Lake, or Tide Gauge
- ✓ Aerial Photographs
- ___ Other

___ No Recorded Data Available

Field Observations:

Depth of Surface Water: _____ (in.)

Depth to Free Water in Pit: _____ (in.)

Depth to Saturated Soil: _____ (in.)

Wetland Hydrology Indicators:

✓ Primary Indicators:
- ___ Inundated
- ___ Saturated in Upper 12 Inches
- ✓ Water Marks
- ✓ Drift Lines
- ✓ Sediment Deposits
- ___ Drainage Patterns in Wetlands

Secondary Indicators (2 or more required):
- ___ Oxidized Root Channels in Upper 12 Inches
- ___ Water-Stained Leaves
- ___ Local Soil Survey Data
- ___ FAC-Neutral Test
- ___ Other (Explain in Remarks)

Remarks:

A #6 Photos 11 downstream ✓ 12 upstream ✓
A #7 Photos 13 downstream ✓ 14 upstream ✓
A #8 Photos 15 downstream ✓ 16 upstream ✓
A #9 Photos 17 downstream ✓ 18 upstream ✓
A #10 Photos 21 downstream ✓ 22 upstream ✓
A #Trib 9 Photo B-24
A Trib 7 Photo 1 downstream w/ drift lines

PROJECT: IMPERIAL - CHEMGOLD INC.

WATERS OF THE U.S. FIELD DATA FORM

Date: 10/7/94
Data Form Number: #2 WATERS "B"

Habitat Type: DESERT WASH / DESERT SCRUB Slope: 3-5%
Waters of US Present: YES Aspect: SOUTHERLY
OHWM Present: YES
Bank Lines: NARROW CHANNELED BANKS TO BRAIDED CHANNELING.
Shelving: IN SHARP BANKS SHELVING WAS PRESENT
Veg. Break: NO EVIDENCE OF VEG. DAMAGE
Litter/Debris: SOME DEBRIS DEPOSITION ON BOOTS. IN CURVES.
Surface Scouring: NONE

Channel Description: JUST ABOVE THE CONFLUENCE OF WATERS "B" WITH WATERS "A", THE CHANNEL IS VERY BROADED W/ ISLANDS OF VEG. CHANNEL NARROWS UPSTREAM AND BECOMES INCISED W/ VERY DAMAGED VEG. DEPOSITION & CHANNEL ROUTE. DEPOSITION OF FINDS <1 MM WITH SOME COBBLES IN BOTTOM. WATERCOURSE BEGINS WITH A MAZE OF MANY SHORT TRIBUTARIES AT THE BASE OF BOUNDARY LINE
Width and Depth Measured at ~~1 MM - 3 MM~~ Intervals.
7 MEASUREMENTS TAKEN & PHOTOS OF WASH AT EACH MEASUREMENT INCREMENT
Soil Particle Size: <1 MM FINDS TO >3CM COBBLES.

Direction of Flow: SOUTH

Ephemeral ✓ Perennial _____

Number of Tributaries 4.
Description:

B-T1 - At headwaters shallow w/inconsistent channeling; approx. 3 ft wide average, w/some shelving / deposition of finds <1 mm - 3CM, channel becomes more defined and later braided in flatter terrain. Water marks on stones & dry cracked soil in channel. After confluence w/ WATERS "B", width av. is 20ft, w/ 30 ft widths. Average depth 2-6 inches. Below bank at area confluence.

B-T2 - Average width 20 ft. Average depth 6-8 inches. Defined channel with no apparent shelving; sandy bottom. Very little veg. debris deposition.

B-T3 - Headwaters originate w/ sheet erosion & becomes channeled. Channel bank to bank greater than WATERS "B" Average Width 27 ft - includes dividing of many small channels. Areas of deposition of finds <1/mm; sandy bottom w/gravel & cobbles. Average depth 6 inches. shelving

B-T4 - Average depth 6 inches; Average Width 9 ft. Defined channel, no veg. debris no shelving, deposition of finds <1 mm.

8.

9.

10.

R & J.P.

IMPERIAL PROJECT
WATERCOURSE SURVEY

Date: 10/7/94 "B"-MEASUREMENTS # B-M1 → B-M7 TAKEN AT 1,000 - 2000FT INTERVALS

Watercourse #: "B" TRIBUTARIES # B-T1 → B-T4

("MAP A-T-M") WATERS "B"

Sample Number	Topo Type1	Defined Bed/Bank	OHWM	Shelves	Veg Break	Scour Bed/BANK	Other	Waters of US	Est. Depth	Est. Width
B-M1	C	Y	Y	Y	N	Y	VEG DEBRIS DEP.	N	25"	51'
B-M2	S→C	VERY BRAIDED Y	Y	N	N	Y	FINDS ¼mm DEPOSITS	Y	13"	24'
B-M3	C	BRAIDED W/ ISLANDS Y	Y	N	N	Y	DEPRESSIONS W/ FIND ¼mm DEPOSIT.	Y	7"	29'
B-M4	C	DEFINED CHANNEL Y	Y	Y	Y	Y	VEG DEBRIS	N	10"	21'
B-M5	C	INCISED CHANNEL Y	Y	Y	Y	Y	SOME BRAIDING FINDS ¼mm & VEG. DEBRIS	N	11"	11 FT.
B-M6	C	INCISED CHANNEL Y	Y	Y	Y	Y	FINDS ¼mm VEG. DEBRIS DEPOSITION	N	5"	5'
B-M7	B→C	VERY BRAIDED Y	Y	Y	N	Y	VEG DEBRIS & FINDS ¼mm DEPOSITED	Y	6"	35'
WATERS "B" TRIBS ("MAP A-B") B-T1	C	BRAIDED Y	Y	Y	Y	Y	VEG DEBRIS & FINDS ¼mm DEPOSITS	Y	AV. 4"	AV 16.5'
B-T2	C	DEFINED CHANNEL Y	Y	N	N	Y	LITTLE VEG. DEBRIS DEPOS.	N	AV 7"	AV 20'
B-T3	S→C	BRAIDED CHANNELS Y	Y	Y	N	Y	VEG. DEBRIS & FINDS ¼mm DEPOSIT.	N	AV 6"	AV 27'
B-T4	C	DEFINED CHANNEL	Y	N	N	Y	FINDS ¼mm DEPOSITED	N	AV 5"	AV 9'

SAME AS A-T1 ?

1 C-CHANNEL, S-SWALE, D-GENERIC DRAINAGE

NOTES: WATERCOURSE AT N PROJECT BOUNDARY BRAIDED W/ NUMEROUS DRAINAGES FEEDING INTO CHANNELS. WATERCOURSE BECOMES A SINGLE CHANNEL DOWNSTREAM & MORE INCISED. BRAIDING & SHALLOW CHANNELS DEVELOP DOWNSTREAM TOWARDS S PROJ. BOUNDARY - CONFLUENCES W/ TRIBUTARIES INFLUENCE DEGREE OF BRAIDING.

WATERS "B" ENTIRE REACH (LENGTH) ≐ 8,625 FT

WATERS "B" & TRIBUTARIES CUMMULATIVE LENGTHS = 14,625 FT

Roll #2 #2 WATERS "B".
✓Photo #2 - from main channel up. WASH E

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site: IMPERIAL
Applicant/Owner: CHEMGOLD
Investigator: R:JP

Date: 10/7/94
County: Imperial
State: CA

Do Normal Circumstances exist on the site? (Yes) No
Is the site significantly disturbed (Atypical Situation)? Yes (No)
Is the area a potential Problem Area? Yes (No)
(If needed, explain on reverse.)

Community ID: DW
Transect ID: ~~A~~ B ~~DISTURB~~ TO A
Plot ID: 1 of 2

VEGETATION

	Dominant Plant Species	Stratum	Indicator
*	1. Olneya tesota		
*	2. Cercidium floridum		
*	3. Hymen. salsola		
	4. Lycium andersonii		
	5. Nicotiana trigonophylla		
	6. Acacia greggii		
	7. Opuntia basilaris		
*	8. Larrea tridentata		
*	9. Encelia farinosa		
	10. Lepidium lasiocarpum		
*	11. Ambrosia dumosa		
	12. Opuntia acanthocarpa		
	13. Chamaetis sp.		
	14. Corizanthe rigida		
	15. Cryptantha sp		
	16. Erioneuron pulchellum		

Percent of Dominant Species that are OBL, FACW or FAC (excluding FAC-).

Remarks:
* - indicates dominants

HYDROLOGY

___ Recorded Data (Describe in Remarks):
___ Stream, Lake, or Tide Gauge
✓ Aerial Photographs
___ Other
___ No Recorded Data Available

Field Observations:

Depth of Surface Water: 0 (in.)
Depth to Free Water in Pit: 0 (in.)
Depth to Saturated Soil: 0 (in.)

Wetland Hydrology Indicators:
Primary Indicators:
___ Inundated
___ Saturated in Upper 12 Inches
✓ Water Marks
___ Drift Lines
✓ Sediment Deposits
✓ Drainage Patterns in ~~Wetlands~~
Secondary Indicators (2 or more required):
___ Oxidized Root Channels in Upper 12 Inches
___ Water-Stained Leaves
___ Local Soil Survey Data
___ FAC-Neutral Test
___ Other (Explain in Remarks)

Remarks: occasional braiding, mostly overland sheet flow

LANDSCAPE POSITION - Dry wash tributary to "A"
SLOPE
ASPECT

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site: IMPERIAL Applicant/Owner: CHEMGOLD Investigator:	Date: 10/7/94 County: IMPERIAL State: CA
Do Normal Circumstances exist on the site? (Yes) No Is the site significantly disturbed (Atypical Situation)? Yes No Is the area a potential Problem Area? Yes No (If needed, explain on reverse.)	Community ID: DRY WASH Transect ID: B-WASH Plot ID: 2 OF 2

VEGETATION

Dominant Plant Species	Stratum	Indicator	Dominant Plant Species	Stratum	Indicator
X A. CERCIDIUM FLORIDUM			9. OPUNTIA BIGELOVII		
X 2. OLNEYA TESOTA			10. OPUNTIA BASILARIS		
3. ACACIA GREGGII			11. OPUNTIA ACANTHICARPA		
4. LARREA TRIDENTATA			12. HYPTIS EMORYI		
5. LYCIUM ANDERSONII			13. CHAMAESYCE ALBO.		
X 6. HYMENOCLEA SALSOLA			14. HILARIA RIGIDA		
X 7. ENCELIA FARINOSA			15. CALLIANDRIA ERIOPHYLLA		
8. SIMMONDSIA CALIFORNICA			16. ERIOGONUM INFLATUM		

Percent of Dominant Species that are OBL, FACW or FAC (excluding FAC-).

Remarks:
X = DOMINANTS

HYDROLOGY

___ Recorded Data (Describe in Remarks):
___ Stream, Lake, or Tide Gauge
✓ Aerial Photographs
___ Other
___ No Recorded Data Available

Field Observations:

Depth of Surface Water: 0 (in.)

Depth to Free Water in Pit: 0 (in.)

Depth to Saturated Soil: 0 (in.)

Wetland Hydrology Indicators:
Primary Indicators:
___ Inundated
___ Saturated in Upper 12 Inches
✓ Water Marks
___ Drift Lines
✓ Sediment Deposits
✓ Drainage Patterns in Wetlands
Secondary Indicators (2 or more required):
___ Oxidized Root Channels in Upper 12 Inches
___ Water-Stained Leaves
___ Local Soil Survey Data
___ FAC-Neutral Test
___ Other (Explain in Remarks)

Remarks: PHOTS B-M3 - #4 DOWN #5 UP B-T3 - #8 DOWN #9 UP B-M5 #11 DOWN #12 UP
B-M4 - #6 DOWN #7 UP B-T4 #10 UP B-M6 - #13 DOWN #14 UP
B-M7 - #15 UP #16 DOWN B-T1 #17 UP #18 DOWN

KINROSS SILVERADO — HEMLOCK INC.

WATERS OF THE U.S. FIELD DATA FORM

Date: 10/8/91
Data Form Number: #3 Waters "C"

Habitat Type: Desert Wash / Desert Scrub Slope: 2-5%
Waters of US Present: YES Aspect: S
OHWM Present: YES
Bank Lines: ON STEEPLY-CUT BANKS, EDGE OF BANK, IS SAND DEPOSITION.
Shelving: ON STEEPLY-CUT BANKS.
Veg. Break: SOME DAMAGED (BY FLOW) VEG., EXPOSED ROOTS
Litter/Debris: COLLECTED IN NICHES - ROOTS, SHRUBS, ON ROCKS.
Surface Scouring: BANKS AND SURFACE WITH SOME EVIDENCE OF SCOURING W/ DEPOSITION OF FINDS <1mm
Channel Description: HEADWATERS NEAR PROJECT BOUNDARY W/ 1 MAIN CHANNEL OF 14 FT WIDTH. WATERCOURSE WIDENS AND BECOMES VERY BRAIDED AFTER IT CONFLUENCE WITH "D". DOWNSTREAM OF THIS CONFLUENCE THE WATERCOURSE WIDENS INTO 5 CHANNELS W/ VARYING WIDTHS & DEPTHS & YES, ISLANDS SEPARATING THEM. MANY SMALL TRIBS & ADJACENT SHEET EROSION
Width and Depth Measured at 1500 - 2500 FT Intervals. 6 MEASUREMENTS WERE TAKEN AND PHOTOS RAN.
Soil Particle Size: <1mm TO COBBLES >15CM. FINDS IN DEPOSITION - POOR WATER SWALES WITHIN THE DEFINED CHANNEL.
Direction of Flow: SOUTHERLY

Ephemeral ✓ Perennial _____

Number of Tributaries 8.
Description:

C-T1 — C-T1 BEGINS AS TOPO RELIEF AND BECOMES CHANNELED BELOW MAIN "TRAIL". SHELVING ON LOWER BANKS. DEPOSITION OF FINDS <1mm - 4/CM COBBLES. AV. DEPTH 5", AV WIDTH 6 FT. VARIES FROM 3 - 10 FT IN WIDTH W/ SOME CHANNEL BRAIDING

C-T2 — 3 TRIBS FEED INTO THE MAIN WATERCOURSE C-T2. CHANNEL INCISED AND BRAIDED WITH VEG. ISLANDS. SHELVING PRESENT ON LOWER BANKS. SOIL FINDS <1mm W/ COBBLES 7 4CM - GRAVEL AND SANDY BOTTOM. AV DEPTH 4" AV WIDTH 6 FT.

C-T3 — AVERAGE DEPTH 4-16 INCHES; AV. WIDTH 3-10 FT. CHANNEL W/ DEFINED BANKS UNTIL IT CONFLUENCE WITH WATERS "C", WHERE IT IS BRAIDED. SHELVING ON LOW BANKS; FINDS <1mm WITH COBBLES 7 4CM

C-T4 — AV. DEPTH 6-12 INCHES, AV. WIDTH 3 FEET. CHANNEL INCISED WITH SHEET FLOW ADJACENT TO CHANNEL SHELVING ON LOWER BANKS; APPEARS AS PART OF WATERS "C" FLOODPLAIN. FINDS DEPOSITED <1mm W/ COBBLES

C-T5 — AV. DEPTH 4 INCHES, AV WIDTH 3 FEET. CHANNEL IS INCISED IN PORTIONS AND BRAIDED IN PORTIONS TOP OF WATERS (N) ORIGINAL AS TOPO RELIEF & SHEET EROSION — CHANNEL FADES OUT.

C-T6 — AV. DEPTH 6 INCHES; AV WIDTH 3 FEET. UPPER REACHES ORIGINATE AS SHEET FLOW - CHANNEL BECOMES INCISED W/ SHELVING ON LOWER BANKS, DEPOSITED FINDS <1mm, COBBLES TO 3CM.

C-T7 — AV. DEPTH 4-12 INCHES, AV. WIDTH 2-6 FT. SHELVING ON SHARP BANKS OF INCISED CHANNELS. DEPOSITION OF FINDS <1mm W/ COBBLES OF >3CM.

C-T8 — (C-T8 = "D" #4 MEASUREMENT). VERY BRAIDED JUST ABOVE CONFLUENCE W/ WATERS "C" 3 CHANNELS W/ SANDY BOTTOM, FINDS >3mm W/ DRIFT DEPOSITION PATTERNS. VEG. DEBRIS DEPOSITS ON SHRUBS & TREE ROOTS. BANK LINES & SHELVING

IMPERIAL PROJECT
WATERCOURSE SURVEY

Date: 10/8/94
Watercourse #: "C" - MEASUREMENTS #C-M1 → C-M6 TAKEN AT 1500 - 2500 FT INTERVALS

Sample Number	Topo Type1	Defined Bed/Bank	OHWM	Shelves	Veg Break	Scour Bed/ BANK	Other	Waters of US	Est. Depth INCHES	Est. Width FEET
C-M1	C	DEFINED CHANNEL Y	Y	Y	N	Y	VEG DEBRIS & FINDS 4mm DEPOSITED	Y	19"	14.5'
C-M2	C	DEFINED CHANNEL Y	Y	Y	Y	V	VEG. DEBRIS DEPOSITED ROOTS/SHELLS	Y	15"	20'
C-M3	C	INCISED CHANNEL Y	Y	BANK LINES Y	Y	Y	VEG. DEBRIS & FINDS 4mm DEPOSITED	N	13"	15'
C-M4	C	INCISED WIDE CHANNEL Y	Y	Y	Y	Y	VEG. DEBRIS & SAND DEPOSITION	Y	14"	62'
C-M5	C	BRAIDED W/ DEFINED W/ E BANKS Y	Y	Y	Y	Y	ISLANDS VEG. DEBRIS DEPOSITION FINDS 4mm	Y.	16"	184'
C-M6	C	5 MAIN CHANNELS W/IN BANKS Y	Y	Y	Y	Y	ISLANDS VEG. DEBRIS & FINDS 4mm DEPOSITED	N	13.2 av. 20 dep.	238 FT - TOTAL BREADTH OF WATERCOURSE
C-M6 - EACH CHANNEL	C	Y	Y	Y	Y	Y	"	N	20"	23'
	C	Y	Y	Y	Y	Y	"	N	8"	43'
	C	Y	Y	Y	Y	Y	"	N	10"	19'
	C	Y	Y	Y	Y	Y	"	N	10"	24'
									18"	21'

EAST ↓ WEST

1 C-CHANNEL, S-SWALE, D-GENERIC DRAINAGE.

NOTES: SOUTHERN END OF WATERS "C" (AFTER CONFLUENCE W/ WATERS "D") BECOMES VERY FLAT, WIDE, AND BRAIDED. ADJACENT AREAS ON BOTHS SIDES OF BANKS, INTRICATELY AND INCONSISTENTLY CHANNELED / SHEET FLOW MAIN WATERCOURSE BECOMES A MAZE OF BROIDED CHANNELS.

WATERS "C" ENTIRE REACH (LENGTH) = 9,250 FT

13-20

IMPERIAL PROJECT
WATERCOURSE SURVEY

Date: 10/8/94 "C" - TRIBUTARIES C-T1 → C-TB
Watercourse #:

Sample Number	Topo Type1	Defined Bed/Bank	OHWM	Shelves	Veg Break	Scour Bed/ BANK	Other	Waters of US	Est. AV. Depth INCHES	Est. AV. Width FEET
C-T1	D→ C	BRAIDED CHANNELS Y	Y	Y	N	Y	DEPOSITION OF FINDS <1mm	N	5"	6'
C-T2	C	INCISED, BRAIDED CHANNELS Y	Y	Y	N	Y	VEG ISLANDS FINDS <1mm	N	4"	6'
C-T3	C	CONFINED TO CONFLUENCE Y	Y	BANK LINES Y	N	Y	FINDS <1mm DEPOSITED	N	11"	6.5'
C-T4	C	INCISED CHANNEL Y	Y	Y	N	Y	CONFLUENCES W/"C" FINDS <1mm DEPOSITS	N	9"	6.5'
C-T5	S→ C	INCISED/BRAIDED CHANNEL Y	Y	Y	N	Y	FINDS <1mm DEPOSITED	N	4"	3'
C-T6	S→ C	DEFINED CHANNEL Y	Y	Y	N	Y	FINDS <1mm DEPOSITS	N	6"	3'
C-T7	C	INCISED CHANNEL Y	Y	Y	N	Y	FINDS <1mm DEPOSITED	Y	8"	4'
C-TB	C	VERY BRAIDED CHANNELS Y	Y	Y	Y	Y	VEG DEBRIS & FINDS <1mm DEPOSITED	N	AV. WIDTH OF CHANNELS 7.3"	TOTAL BANK TO BANK 223'
C-TB EACH CHANNEL	C	Y	Y	Y	Y	Y	ISLANDS BETWEEN CHANNELS	N	6"	24'
	C	Y	Y	Y	Y	Y	↓	N	8"	28'
	C	Y	Y	Y	Y	Y		N	8"	12'

= "D" - M4
EAST
↓
WEST

1 C-CHANNEL, S-SWALE, D-GENERIC DRAINAGE

NOTES:

"C" TRIBUTARIES CUMMULATIVE LENGTHS = 15,500 FT

Note: all major drainages [illegible] (Phorodendron) the ironwood-Olneya tesota

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

#3 Waters "C"

Project/Site: Imperial
Applicant/Owner: Chemgold
Investigator: JR+JP

Date: 10/8/94
County: Imperial
State: CA

Do Normal Circumstances exist on the site? (Yes) No
Is the site significantly disturbed (Atypical Situation)? Yes (No)
Is the area a potential Problem Area? Yes (No)
(If needed, explain on reverse.)

Community ID:
Transect ID: C
Plot ID: Sheet #1 of 2 for "C"

VEGETATION * = Dominant Veg

	Dominant Plant Species	Stratum	Indicator
T2, C1	1. Hilaria rigida *	C3	upl
C2 T2, C1	2. Olneya tesota *	C3	upl
C2 T2, C1	3. Encelia farinosa *		upl
*T2	4. Fouquieria splendens		upl
C2, T2	5. Ambrosia dumosa	upl.	*C3 *C2
T2	6. Larrea tridentata	upl.	C3
C2, T2	7. Chamaesyce albomarginata	upl	
T2	8. Opuntia acanthocarpa	upl	
T2	9. Opuntia basilaris	upl	
T2	10. Cuttereria sarothrae		
T2	11. Linear leaf w/ fruit (C) Euphorb?		
T2	12. Spiny grey-blue - Krameria erecta?		
T2	13. Calliandra eriophylla		
C2	14. Lycium andersonii		
C2	15. Acacia greggii		
C2	16. Hymenoclea salsola		
C3, C2	Eriodictyon trichocalyx		
C2	Ferocactus cylindraceus		
C2	Hyptis emoryi		
C3	Aster shrub - yellow flowers?		
C3	Simmondsia californica		
C3	Cuscuta (Dodder)		

Percent of Dominant Species that are OBL, FACW or FAC (excluding FAC-).

Remarks:

HYDROLOGY

___ Recorded Data (Describe in Remarks):
___ Stream, Lake, or Tide Gauge
✓ Aerial Photographs
___ Other
___ No Recorded Data Available

Field Observations:
Depth of Surface Water: _____ (in.)
Depth to Free Water in Pit: _____ (in.)
Depth to Saturated Soil: _____ (in.)

Wetland Hydrology Indicators:
Primary Indicators:
___ Inundated
___ Saturated in Upper 12 Inches
✓ Water Marks
✓ Drift Lines
✓ Sediment Deposits
___ Drainage Patterns in Wetlands
Secondary Indicators (2 or more required):
___ Oxidized Root Channels in Upper 12 Inches
___ Water-Stained Leaves
___ Local Soil Survey Data
___ FAC-Neutral Test
___ Other (Explain in Remarks)

Remarks:
Photo roll #2

CM1 photos 18 downstream ✓
19 upstream ✓

CM2 photos 21 downstream ✓
22 upstream ✓

CT2 photo 20 downstream ✓

CM3 photos 23 downstream ✓
24 upstream ✓

#3 Waters "C"

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site: Imperial
Applicant/Owner: Chemgold
Investigator: JP & JR

Date: 10/8/94
County: Imperial
State: CA

Do Normal Circumstances exist on the site?	Yes	No
Is the site significantly disturbed (Atypical Situation)?	Yes	No
Is the area a potential Problem Area? (If needed, explain on reverse.)	Yes	No

Community ID: _____
Transect ID: C
Plot ID: page 2 of 2 for C

VEGETATION

	Dominant Plant Species	Stratum	Indicator
C4	1. Hyptis emoryi	T5	
T5, C4	2. Cercidium floridum		
C	3. Hymenoclea salsola		
T4 C	4. Olneya tesota	T5	
C	5. Opuntia acanthocarpa		
C	6. Lycium andersonii		
T4, C	7. Encelia farinosa		
C	8. Acacia greggii		
	9. Opuntia acan	C-T5, T5	
	10. Opu basilaris	C-T5, T5	
	11. larrea tri.	C, T5	
	12. Fouquieria splendens between	C-Trib 5, T5	
	13. Hilaria rigida	Trib 5 - hill, CT5*	
T5	14. Simmondsia californica		
T5	15. Calliandra eriophylla		
T5	16. Chamaesyce albomarginata		

Percent of Dominant Species that are OBL, FACW or FAC (excluding FAC-). Spiny, Krameria erecta? T5

Remarks: C6 meas: channel 0-23 20" Island 116-149 sl. living debris
Island 23-41 Channel 149-173 - 10"/24'
43' channel 41-84 8" Island 173-217
19' Island 84-97
Channel 97-116 16" Channel 217-238 - 1.8" 21'

HYDROLOGY

___ Recorded Data (Describe in Remarks):
___ Stream, Lake, or Tide Gauge
✓ Aerial Photographs
___ Other
___ No Recorded Data Available

Field Observations:

Depth of Surface Water: _____ (in.)

Depth to Free Water in Pit: _____ (in.)

Depth to Saturated Soil: _____ (in.)

Wetland Hydrology Indicators:
Primary Indicators:
___ Inundated
___ Saturated in Upper 12 Inches
✓ Water Marks
✓ Drift Lines
✓ Sediment Deposits
___ Drainage Patterns in Wetlands
Secondary Indicators (2 or more required):
___ Oxidized Root Channels in Upper 12 Inches
___ Water-Stained Leaves
___ Local Soil Survey Data
___ FAC-Neutral Test
___ Other (Explain in Remarks)

Remarks: C5 meas 0-63 channel 63 16" 168-184 channel 6" deep = 16'
63-96 island
96-132 End Channel 36" 10-12"
132-168 Island

CM4 photos #24 down on Roll #2 ✓ CM5 - photos 3 down 4 up } main channel

Roll #3 C4 photos 1 Downstream ✓
2 Upstream ✓ CM6 - photo 5 up
6 D) East to West ✓
7 DS ✓
* upstream ✓

Photos 9, 10, 11, 12 adjacent waters end sheet blow at lower end of "C" some is channelized, some not cer flor, Olnites, larr tri Opu aca, Barrel cactus, Opu ba

PROJECT: IMPERIAL - CHEMGOLD, INC.

WATERS OF THE U.S. FIELD DATA FORM

Date: 10/3/94
Data Form Number: #4 WATERS "D"

Habitat Type: DESERT SCRUB - DRY WASH Slope: 0-5%
Waters of US Present: YES Aspect: S
OHWM Present: YES
Bank Lines: INCISED BANKS WITH APPARENT WATER LINES - SHELVING
Shelving: ON SHEER BANKS AT LOWER PORTIONS
Veg. Break: VERY LITTLE VEG. DAMAGE
Litter/Debris: LOTS OF VEG. DEBRIS ON ROOTS, SHRUBS, ROCKS.
Surface Scouring: SOME BANK & BOTTOM SCOURING APARENT.

Channel Description: ENTIRE CHANNEL FROM N. PROJECT BOUNDARY BRAIDED W/ SMALL ISLANDS W/ VEGETATION. WATERCOURSE IS BRAIDED, AND SOME CHANNELS DEEPLY INCISED. WATERCOURSE VERY BROAD AT CONFLUENCE W/ WATERS "C" - 3 CHANNELS WITHIN THE WATERCOURSE TOTALING WIDTH OF 223 FT.
Width and Depth Measured at 1,000 - 2,000 FT Intervals. 4 MEASUREMENTS TAKEN AND PHOTOS.
Soil Particle Size(s): FINDS OF 4MM WITH LARGE COBBLES >20CM

Direction of Flow: SOUTHERLY

Ephemeral ✓ Perennial _____

Number of Tributaries 2.
Description:

#5
D-T 1 - AV. DEPTH 8 INCHES, AV. WIDTH 25 FEET. LARGE INCISED CHANNEL W/ FINDS <1 MM, COBBLES AND SEDIMENT DRIFT PATTERNS, BANKSCOURING AND SHELVING. LARGE TRIB. TO WATERS "D"
D-T 2 - AV. DEPTH 5 INCHES: AV. WIDTH 3.5 FEET. WATERCOURSE BEGINS AFTER TOPO RELIEF & SHEET EROSION DEVELOP INTO DEFINED CHANNELS. TRIB D-T2 IS BRAIDED W/ SHELVING & LOWER BANK DEPOSITIONS OF FINDS <1 MM. WATERCOURSE & OHWM FADES INTO SHEET FLOW IN ITS NORTHERN REACHES.

4.

5.

6.

7.

8.

9.

10.

JR & J.P.

IMPERIAL PROJECT
WATERCOURSE SURVEY

Date: 10/3/94

Watercourse #: "D" - MEASUREMENTS #D-M1 → D-M4 TAKEN AT 1,000 - 2,000 FT INTERVALS
"D" TRIBUTARIES #D-T1 → D-T2

Sample Number	Topo Type1	Defined Bed/Bank	OHWM	Shelves	Veg Break	Scour Bed	Other	Waters of US	Est. Depth	Est. Width
D-M1	C	2 CHANNELS Y	Y	Y	N	Y	VEG. ISLAND VEG DEBRIS FINDS ≤ 1mm DEPOSITED	Y	14"	(E-28 FT CHANNELS 14FT) 70' - TOTAL
D-M2	C	BRAIDED Y	Y	Y	N	Y	SOIL & VEG. DEBRIS DEPOSITION	N	12"	81'
D-M3	C	CONFINED CHANNEL Y	Y	Y	Y	Y	VEG. DEBRIS & FINDS ≤ 1mm DEPOSITED	Y	16.5"	54'
D-M4	C	BRAIDED - 3 CHANNELS Y	Y	Y	N	Y	VEG DEBRIS & SAND DEPOSITION	N	17.3"	(E-24' MID-28 FT CHANNELS W-12 FT) 223
WATERS "D" TRIBS D-T1	C	INCISED CHANNEL Y	Y	Y	N	Y	VEG DEBRIS FINDS ≤ 1mm DEPOSITS	N	AV 8"	AV. 15 FT
D-T2	S→C	DEFINED CHANNEL BRAIDED Y	Y	Y	N	Y	VEG. DEBRIS & FINDS ≤ 1mm DEPOSITED	Y	AV 5"	AV 3.5 FT

1 C-CHANNEL, S-SWALE, D-GENERIC DRAINAGE

NOTES: WATERCOURSE "D" AT N BOUNDARY IS BRAIDED W/ DEFINED CHANNELS & ISLANDS, IT CONFLUENCES W/ D-T1 AND BECOMES VERY BRAIDED. IT THEN BECOMES NARROWER UNTIL JUST BEFORE IT CONFLUENCES W/ WATERS "C," WHERE IT DIVIDES INTO 3 CHANNELS AND BROADENS GREATLY.

WATERS "D" ENTIRE REACH (LENGTH) = 4,000 FT WATERS "D" TRIBUTARIES CUMMULATIVE LENGTH = 6,750 FT

#4/ Waters 4D 01

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site: Imperial
Applicant/Owner: Chemgold
Investigator: JP/JR

Date: 10/8/94
County: Imperial
State: CA

Do Normal Circumstances exist on the site? (Yes) No
Is the site significantly disturbed (Atypical Situation)? Yes No
Is the area a potential Problem Area? Yes No
(If needed, explain on reverse.)

Community ID: _____
Transect ID: "D"
Plot ID: page 1 of 1

* = Dominant veg

VEGETATION

	Dominant Plant Species	Stratum	Indicator
D T2	T1. Larrea tridentata		
*T2 *D	T2. Encelia farinosa		
D*	T3. Lycium andersonii		
T2 D	T4. Opuntia basilaris		
*T2 *D	T5. Oneja tesota		
*T2	T6. Hilaria rigida		
D	T7. Stipis emoryi		
D	T8. Hymenoclea salsola		
	T9. Callandria eriophylla	alluvial drainage	
D	T10. Cryptantha sp.		
	T11. Fouquieria splendens		
	T12. Chamaesyce albomarginata		
	T13. Ambrosia dumosa		
D	T14. Cercidium floridum		
	T15. Simmondsia californica		
	T16. Opuntia acanthocarpa		
	T2 Ferocactus cylindraceus		
	T2 Krameria erecta		

Percent of Dominant Species that are OBL, FACW or FAC (excluding FAC-).

Remarks: Measure D1 channel 28'
Island 17-45' = 28'
channel 45-59' = 14' ponding 10"
D2 7'
43-81 38'
D4 C 0-12, 12' 8" Deep I 12-57 C 57-85, 28' 6" Deep
Is 85-199
Ch 199-223, = 4' 10" deep

HYDROLOGY

___ Recorded Data (Describe in Remarks):
___ Stream, Lake, or Tide Gauge
✓ Aerial Photographs
___ Other
___ No Recorded Data Available

Field Observations:

Depth of Surface Water: _____ (in.)
Depth to Free Water in Pit: _____ (in.)
Depth to Saturated Soil: _____ (in.)

Wetland Hydrology Indicators:
Primary Indicators:
___ Inundated
___ Saturated in Upper 12 Inches
✓ Water Marks
✓ Drift Lines
✓ Sediment Deposits
___ Drainage Patterns in Wetlands
Secondary Indicators (2 or more required):
___ Oxidized Root Channels in Upper 12 Inches
___ Water-Stained Leaves
___ Local Soil Survey Data
___ FAC-Neutral Test
___ Other (Explain in Remarks)

Remarks:

Roll #3

DT1 photo #13 downstream ✓ DM3 18 Down ✓
DM1 photo # 14 down ✓ 19 up ✓
15 up ✓ DM4 20 Upstream ✓
DM2 photo 16 down ✓ 21 Down ✓
17 up ✓

PROJECT: IMPERIAL - CHEMGOLD, INC.

WATERS OF THE U.S. FIELD DATA FORM

Date: 10/3/94
Data Form Number: #5 WATERS "E"

Habitat Type: DESERT SCRUB - DESERT UNION Slope: 3-5%
Waters of US Present: YES Aspect: S
OHWM Present: YES
Bank Lines: CHANNELS W/ BANKS AND WATER LINES
Shelving: SOME SHELVING ON LOW BANKS
Veg. Break: SOME VEG. WITH FLOW DAMAGE & EXPOSED ROOTS.
Litter/Debris: VEG. DEBRIS CAUGHT ON ROOTS, SHRUBS ROCKS - PUSHED BY FLOW
Surface Scouring: WATER STAINED CRACKED MUD - DRIED MUDDY POOLS IN LOW SPOTS OF CHANNEL. NO SIGNIFICANT SCOURING NOTED.
Channel Description: WATERCOURSE "E", AT THE N END OF THE PROJECT, IS COMPOSED OF A CONCISE CHANNEL WHICH BROADS AS IT CONFLUENCES W E-T7. CHANNEL BECOMES VERY BROAD AT [illegible] PROJECT BOUNDARY AND NUMEROUS TRIBS ENTER THE WATERCOURSE.
Width and Depth Measured at LOOP-INTERVAL Intervals. 7 MEASUREMENTS AND CORRESPONDING SITE PHOTOGRAPHS WERE TAKEN.
Soil Particle Size: FINDS DESIGNATED <1/4 IN W/ COBBLES OF 10-15 CM

Direction of Flow: SOUTHERLY

Ephemeral ✓ Perennial _____

Number of Tributaries 11.
Description:

#

E-T 1 - AV. DEPTH 2.5 INCHES; AV. WIDTH 5 FEET, SHALLOW CHANNELING W/ SOME BRAIDING. NO TRUE SHELVES AND A ROCKY BED-BASED.

E-T 2 - AV. DEPTH 3 INCHES; AV. WIDTH 5 FEET. BRAIDED SHALLOW CHANNELS W/ SANDY GRAVEL BOTTOM LOWER REACHES MORE INCISED CHANNELING W/ SHELVING ON LOW BANKS, SCOURED BED; BANKS DEPOSITION OF CRACKED DRIED SOIL & VEG DEBRIS IN ROOTS, SHRUBS.

E-T 3 - AV. DEPTH 3 INCHES; AV. WIDTH 4 FEET. GRAVEL & COBBLE BED. BANK SCOURING & SHELVING. DEPOSITION OF FINDS <1/4 IN; DRIFT PATTERNS IN GRAVELS. WASHED DAMAGE TO VEG. AND VEG. DEBRIS DEPOSITION.

E-T 4 - AV DEPTH 3 inches AV. Width 3 feet. Watercourse has defined shallow channel w/ minor shelving, a gravel bed w/ Drift deposition; No veg debris - little veg. growing in channel

E-T 5 - Av. Depth 6 inches; Av. Width 2 feet - incised channeling w/ scoured banks & shelving on banks. Finds <1/4 in in deposited low spots; gravel bed.

ET 6 - Av. Depth 3 inches; Av. width 2.5 feet, Watercourse channeled w/ some shelving on low banks. Gravel bottom - not vegetated; no veg. Deposition. Pockets w/ finds <1/4 in

ET 7 - (E-T7 = West "E" #5 measure) Av. depth 7". Av. Width 9 ft. A west fork tributary N project boundary to West "E". Incised channel w/ braiding, Sandy bed 10. 1/ cobbles & finds <1/4 in deposited. Shelving on banks. Deposition of sand and veg debris - on roots, shrubs, rocks.

E-T 8 - Lots of short sediment trib's to E-T8. Incised braided channeling w/ shelving on banks, deposition of finds <1/4 in; veg debris. Sandy gravel bottom, bed: Hot serving watercourse varies in width of 25 ft 3/4 channels to Av. 4 ft w/ 1 channel. Av. Depth 8 inches.

E-T 9 - Av. Depth 3"; Av. Width 2 ft. - Watercourse braided w/ incise channeling - shelving w/ sandy gravel bed, little veg. debris. Deposition of finds <1/4 in - 2 in cobbles.

E-T 10 - Av. Depth 3" Av. Width 2 ft Braided watercourse w/ incised channels, gravel cobbled bed [illegible] channel removed. No veg. in channel. Top of trip banks w/ top of hills - sheet erosion 2-3 inch. AVER

RB #

E-T11 — Av. Depth 4 inches. Av Width ≥ 5 ft; sandy gravel bed. Watercourse bordered w/ incised channels. HW on hill w/ basalt flow. Banks shelved w/ some bank lines & scouring. No veg. in channel or deposition of veg. debris.

J.P. : J.R.

IMPERIAL PROJECT
WATERCOURSE SURVEY

Date: 10/8/94

Watercourse #: "E" - TRIBUTARIES # ET1 → ET11

Sample Number	Topo Type1	Defined Bed/Bank	OHWM	Shelves	Veg Break	Scour Bed / BANKS	Other	Waters of US	Est. Av. Depth INCHES	Est. Av. Width FEET
E-T1	SHALLOW S→C	SHALLOW BANKS Y	Y	N	N	Y	ROCKY BED OF CHANNEL PROJECT	N	2.5"	5'
E-T2	C	BRAIDED / SHALLOW INTO MORE DEFINED Y	Y	Y	N	Y	VEG. DEBRIS DEPOSITION CRACKED DRIED MUD	N	3"	5'
E-T3	C	DEFINED BANKS CHANNEL Y	Y	Y	Y	Y	VEG. DEBRIS & FINDS LIAM DEPOSITION DRIFT LINES	N	3"	4'
E-T4	C	SHALLOW, DEFINED CHANNEL Y	Y	Y	N	Y	DRIFT DEPOSITION	N	3"	3'
E-T5	C	INCISED CHANNEL Y	Y	Y	N	BANKS Y	FINDS LIAM DEPOSITION	N	6"	2'
E-T6	C	DEFINED CHANNEL Y BRAIDED	Y	Y	N	Y	POCKETS OF FINDS LIAM DEPOSITED	N	3"	2.5'
E-T7	C	INCISED CHANNEL Y	Y	Y	Y	Y	VEG. DEBRIS & FINDS LIAM DEPOSITED	N	7"	9'
E-T8	C	INCISED / BRAIDED CHANNELING Y	Y	Y	N	Y	VEG. DEBRIS & FINDS LIAM DEPOSITED	N	8"	4 CHANNELS 25' TOTAL
E-T9	C	INCISED / BRAIDED CHANNELS Y	Y	Y	N	Y	VEG. DEBRIS FINDS LIAM DEPOSITED	N	3"	2'
E-T10	S→C	BRAIDED / INCISED CHANNELING Y	Y	Y	N	Y	STARTS W/ SHEET EROSION	N	3"	2'
E-T11	C	BRAIDED / INCISED CHANNELS Y	Y	Y	N	Y		N	4"	2.5'

1 C-CHANNEL, S-SWALE, D-GENERIC DRAINAGE

NOTES:

WATERS "E" TRIBUTARIES CUMMULATIVE LENGTHS = 35,000 FT

JR: J.P.

IMPERIAL PROJECT
WATERCOURSE SURVEY

Date: 10/8/94

Watercourse #: "E" - MEASUREMENTS # E-M1 → E-M7 TAKEN AT 1,000 - 1500 FT INTERVALS

Sample Number	Topo Type1	Defined Bed/Bank	OHWM	Shelves	Veg Break	Scour Bed/Bank	Other	Waters of US	Est. Depth INCHES	Est. Width FEET
E-M1	C	INCISED, NARROW CHANNEL Y	Y	Y	N	Y	VEG. DEBRIS DEPOSITION	Y	8"	8'
E-M2	C	INCISED, NARROW CHANNEL Y	Y	Y	N	Y	VEG. DEBRIS DEPOSITED	Y	10"	7'
E-M3	C	CONFLUENCE OF "E" & E-T7 BRAIDED Y	Y	Y	Y	Y	VEG. DEBRIS DEPOSITED	Y	9.5"	16'
E-M4	C	BRAIDED, INCISED CHANNELS Y	Y	Y	Y	Y	VEG DEBRIS & FINDS CLOTH DEPOSITED	N	7"	19'
E-M5	C	BRAIDED, INCISED CHANNELS Y	Y	Y	N	Y	VEG, DEBRIS & SAND DEPOSITS	N	7"	9'
E-M6	C	INCISED CHANNEL Y	Y	Y	Y	BANK Y	VEG. DEPOSITS & FINDS CLOTH DEPOSITED	Y	15"	18 FT
E-M7	C	INTERMITTENT BRAIDS IN CHANNEL Y	Y	Y	Y	BANK Y	VEG DEBRIS & FINDS CLOTH DEPOSITED	N	10"	36'

1 - C-CHANNEL, S-SWALE, D-GENERIC DRAINAGE

NOTES; WATERCOURSE "E" NEAR N. PROT. BOUNDARY W/ INCISED CHANNEL UNTIL IT CONFLUENCES W/ E-T7 AND BECOMES BRAIDED. BRAIDED CHANNELS CONTINUE FOR A DISTANCE, BECOME INCISED, AND BRAIDED AGAIN NEAR S PROT. BOUNDARY

WATERS "E" ENTIRE REACH (LENGTH) = 6,375 FT

#5 WATERS "E"

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site: Imperial Applicant/Owner: Chemgold Investigator: JP/JK	Date: 10/8/94 County: Imperial State: CA
Do Normal Circumstances exist on the site? Yes No Is the site significantly disturbed (Atypical Situation)? Yes No Is the area a potential Problem Area? Yes No (If needed, explain on reverse.)	Community ID: _____ Transect ID: E Plot ID: page 1 of 1

* = dominant veg

VEGETATION

Dominant Plant Species	Stratum	Indicator
E1. *Callandria criophylla	T_3 T_2 T_1	
E2. *Hilaria rigida	T_4 *T_1	
E3. Olneya tesota	*T_1 *T_2 *T_4 *T_3 *T_2 *T_1	
E4. *Encelia farinosa	T_1 T_5 T_4 T_3 *T_2 *T_1	
E5. Cercidium floridum	T_4 T_1	
E6. *Hyptis emoryi	*T_3 *T_4 T_2	
E7. *Hymenoclea salsola		
E8. Lycium andersonii		
E9. Opuntia acanthocarpa		
E10. Fouquieria splendens		
E11. Ambrosia dumosa		
T12. Larrea tridentata		
13. Chamaesyce albomarginata		
T14. Guitierrezia sarothrae		
T15. Krameria erecta		
T16. Ferocactus cylindraceus		

Percent of Dominant Species that are OBL, FACW or FAC (excluding FAC-). _____

Remarks: T_6 2-3' wide, 3" deep
some bank scouring
some shelving
gravel bottom, bare no veg

HYDROLOGY

___ Recorded Data (Describe in Remarks):
- ___ Stream, Lake, or Tide Gauge
- ✓ Aerial Photographs
- ___ Other

___ No Recorded Data Available

Field Observations:

Depth of Surface Water: _____ (in.)

Depth to Free Water in Pit: _____ (in.)

Depth to Saturated Soil: _____ (in.)

Wetland Hydrology Indicators:

Primary Indicators:
- ___ Inundated
- ___ Saturated in Upper 12 Inches
- ✓ Water Marks
- ___ Drift Lines
- ✓ Sediment Deposits
- ___ Drainage Patterns in Wetlands

Secondary Indicators (2 or more required):
- ___ Oxidized Root Channels in Upper 12 Inches
- ___ Water-Stained Leaves
- ___ Local Soil Survey Data
- ___ FAC-Neutral Test
- ___ Other (Explain in Remarks)

Remarks:

Roll #3

Photos: EM2 2 downstream ✓
23 upstream ✓
EM3 Photos 3 downstream ✓
4 upstream ✓
EM7 9 downstream ✓
10 upstream ✓

Roll #4
EM2 Photo 1 down ✓
2 upstream ✓
EM4 Photos 5 down ✓
6 up ✓
7/8 down ✓ upstream ✓
EM8 11 downstream ✓
12 upstream ✓
EM5

PROJECT: TIMPANIAL - CHEMGOLD INC.

WATERS OF THE U.S. FIELD DATA FORM

Date: 10/9/94
Data Form Number: #6 - TRIBS BETWEEN WATERS C & E

Habitat Type: DESERT SCRUB
Slope: 0-2%
Waters of US Present: YES
Aspect: S
OHWM Present: YES
Bank Lines: YES
Shelving: YES
Veg. Break: VERY LITTLE NOTED
Litter/Debris: LITTLE VEG. DEPOSITION
Surface Scouring: - SOME RANIC / BED SCOURING

Channel Description: VARIES W/ EACH TRIBUTARY - SEE NOTES BELOW

Width and Depth Measured at 1 Intervals. - AVERAGES ESTIMATED FOR EACH TRIBUTARY
Soil Particle Size: VARIES W/ EA. TRIBUTARY

Direction of Flow: SOUTHERLY

Ephemeral ✓ Perennial ____

Number of Tributaries 8.

WB #	Description: - NOTES
C&E-T 1	— Av. Depth 2 inches; Av. width 2.5 ft. Defined channel of watercourse begins 500 ft below Main Trail. Sandy gravel bed w/ basalt cobbles. Channel w/ shelving, bank lines, scouring. Deposition of fines Cl a — & veg debris - roots, shrubs. Watercourse becomes very braided w/ 5+ channels
C&E-T 2	— Av. Depth 2.5 inches; Av. Width 2 ft. Watercourse braided incised channels w/ sandy gravel bed, bank lines & shelving, deposition of sands & veg. debris. Loose channeling near confluence w/ C&E-T 1.
C&E-T 3	— Av. Depth 2 inches; Av. width 3 ft. Main watercourse braided into 10 ft w/ incised channels up to 3 ft. Bank lines & shelving & depos. of veg. debris. Deposition of gravels. no veg in bed bottom.
C&E-T 4	— Av. Depth 3" Av. Width 2.5 ft. 2 forks similar. Intermittent channeling & braided at confluence of 2 forks - watercourse becomes ~20 ft wide. Finds Cl a — & deep soils. Depos. of veg d
C&E-T 5	— Av. Depth 3 inches; Av. Width 2 ft. Watercourse very braided w/ shallow channels that collect and become more incised downstream up to 10 ft across at S end & some bank lines & shelving; depos. of veg debris Finds Cl a — a
C&E-T 6	— Av. Depth 3 inches; Av. Width of ea. channel ~ 1 ft. total watercourse of braided channels 12-20 ft wide w/ islands of veg.. Sandy gravel bottom, shelving, bank lines.
C&E-T 7	— Av. Depth 2 inches; Av. Width of ea. 2-3 channels 18 inches - braided watercourse width 15-20 ft. w/ isl of veg. Shallow braided channels. Deposition of sand & gravel - drift lines. little shelving or veg. debris
C&E-T 8	— Av. Depth 3.5 inches; Av. width of main channel 2.5 ft, total width of braided watercourse 20-30 ft Braided watercourse of incised channels w/ bank lines & shelving. Veg debris & soil particle deposits
9.	Bank cuts w/ pockets of dried crack soil. Finds Cl a —. Veg debris & roots
10.	

R & J.P.

IMPERIAL PROJECT
WATERCOURSE SURVEY

Date: 10/9/96

Watercourse #: TRIBUTARIES LOCATED BETWEEN WATERS "C" AND WATERS "E" #C:E-T1 → C:E-T8

Sample Number	Topo Type1	Defined Bed/Bank	OHWM	Shelves	Veg Break	Scour Bed/ BANK	Other	Waters of US	Est. AV. Depth INCHES	Est. AV. Width FEET
C:E-T1	C	DEFINED CHANNEL BECOMES BRAIDED Y	Y	Y	N	Y	1-5 CHANNELS FINDS & AIM ! VEG. DEBRIS DEPOSITION	N	2"	2.5'
C:E-T2	C	BRAIDED/ INCISED CHANNELS Y	Y	Y	N	Y	SAND ! VEG. DEBRIS DEPOS. CHANNELS FINDING NEAR CONFLUENCE W/ C:E-T1	N	2.5"	2'
C:E-T3	C	BRAIDED, INCISED CHANNELS. Y	Y	Y	N	Y	VEG. DEBRIS ! GRAVEL DEPOSITION	N	2"	3'
C:E-T4	C	INTERMITTENT CHANNELS / BRAIDED Y	Y	Y	N	Y	2 FORKS - INFO REPRESENTATIVE VEG. DEBRIS DEPOSITION	N	3"	2.5'
C:E-T5	C	BRAIDED CHANNELS Y	Y	Y	N	N	VEG. DEBRIS ! FINDS & AIM DEPOSITED	N	3"	2'
C:E-T6	C	BRAIDED CHANNELS Y	Y	Y	N	Y	VEG. DEBRIS DEPOSITED	N	3"	ERN CHANNEL 1' WIDE & 16' BANK TO BANK
C:E-T7	S→C	BRAIDED CHANNELS Y	Y	Y	N	Y	DRIFT LINES IN GRAVEL DEPOSITION	N	2"	MAIN CHANNEL 1' 2.5' 18
C:E-T8	C	BRAIDED CHANNELS Y	Y	Y	Y	Y	VEG. DEBRIS ! FINDS & AIM DEPOSITION	N	3.5"	MAIN CHANNEL - 25' 27.5' BANK TO BANK

1 C-CHANNEL, S-SWALE, D-GENERIC DRAINAGE

"C:E" TRIBUTARIES CUMMULATIVE LENGTH = 34,750 FT

#6 TRIBS BETWEEN WATERS "C & E"

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site: Imperial Applicant/Owner: Chemgold Investigator: JP/JR	Date: 10/9/98 County: Imperial State: CA
Do Normal Circumstances exist on the site? (Yes) No Is the site significantly disturbed (Atypical Situation)? Yes No Is the area a potential Problem Area? Yes No (If needed, explain on reverse.)	Community ID: — Transect ID: C, E Tributaries Plot ID: —

* = dominants

VEGETATION

Dominant Plant Species	Stratum	Indicator	Dominant Plant Species	Stratum	Indicator
1. Encelia farinosa	*T8, T2, T3,		9. Ambrosia dumosa	T8	
2. Larrea tridentata	T8, T2, T3,		10. Chamaesyce albomarginata	T8	
3. Olneya tesota	T8		11. Opuntia basilaris	T8	
4. Fouquieria splendens	T8		12. Opuntia acanthocarpa	T8 T3, T2	
5. Hilaria rigida	*T8		13. Krameria erecta	T8	
6. Ferocactus cylindraceus	T8		14. Gutierrezia sarothrae	T8 T3, T2,	
7. Calliandra eriophylla	*T8 T3 T2 T1		15. Acacia greggii	T8	
8. Cercidium floridum	T8		16. Opuntia bigelovii	T3, T2	

Percent of Dominant Species that are OBL, FACW or FAC (excluding FAC-). 12 of 14

Remarks: Photo #14
ET8 upstream, narrow in hilly area ✓
ET8 #15 downstream, more level ✓

HYDROLOGY

___ Recorded Data (Describe in Remarks):
- ___ Stream, Lake, or Tide Gauge
- ✓ Aerial Photographs
- ___ Other

___ No Recorded Data Available

Field Observations:

Depth of Surface Water: _____ (in.)

Depth to Free Water in Pit: _____ (in.)

Depth to Saturated Soil: _____ (in.)

Wetland Hydrology Indicators:

Primary Indicators:
- ___ Inundated
- ___ Saturated in Upper 12 Inches
- ✓ Water Marks
- ✓ Drift Lines
- ✓ Sediment Deposits
- ___ Drainage Patterns in Wetlands

Secondary Indicators (2 or more required):
- ___ Oxidized Root Channels in Upper 12 Inches
- ___ Water-Stained Leaves
- ___ Local Soil Survey Data
- ___ FAC-Neutral Test
- ___ Other (Explain in Remarks)

Remarks:

#6 TRIBS BETWEEN WATERS "C" & "E"

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site: Imperial Applicant/Owner: Chemgold Investigator: JR/JP	Date: 10/9/94 County: Imperial State: CA
Do Normal Circumstances exist on the site? Yes No Is the site significantly disturbed (Atypical Situation)? Yes No Is the area a potential Problem Area? Yes No (If needed, explain on reverse.)	Community ID: E Tribs Transect ID: NE of Plot ID: Trib 2-5 on Drainage "E"

*= Dominant

VEGETATION

Dominant Plant Species	Stratum	Indicator	Dominant Plant Species	Stratum	Indicator
1. Cucurbita Sarcantha T9			9. Acacia greggii T9		
2. Opuntia bigelovii T9, T10			10. Ferocactus cylindraceus T9, T10		
3. *Ambrosia dumosa *T9, T10*			11. Hilaria rigida *T9		
4. Larrea tridentata T9, T10			12. Olneya tesota T9, T10		
5. Encelia farinosa T9, *T10			13. Calliandra eriophylla T9, *T10		
6. Krameria erecta T9, T10			14. Cercidium floridum T9		
7. Opuntia acanthicarpa T9, T10			15. Fouquieria splendens T9, T10		
8. Chamaesyce albomarginata T9, T10			16. Opuntia basilaris T9		

Percent of Dominant Species that are OBL, FACW or FAC (excluding FAC-).

Remarks:
T9, T10 = Olneya tesota overstory dominant, but not dom. in terms of total covers provided.

HYDROLOGY

___ Recorded Data (Describe in Remarks):
- ___ Stream, Lake, or Tide Gauge
- ✓ Aerial Photographs
- ___ Other

___ No Recorded Data Available

Field Observations:

Depth of Surface Water: _____ (in.)

Depth to Free Water in Pit: _____ (in.)

Depth to Saturated Soil: _____ (in.)

Wetland Hydrology Indicators:

Primary Indicators:
- ___ Inundated
- ___ Saturated in Upper 12 Inches
- ✓ Water Marks
- ✓ Drift Lines
- ___ Sediment Deposits
- ___ Drainage Patterns in Wetlands

Secondary Indicators (2 or more required):
- ___ Oxidized Root Channels in Upper 12 Inches
- ___ Water-Stained Leaves
- ___ Local Soil Survey Data
- ___ FAC-Neutral Test
- ___ Other (Explain in Remarks)

Remarks: Roll #4 Photo #16 ET9 upstream ✓
#17 ET10 downstream ✓
#18 } overview - drainages - direction is ✓
#19 } starting at tops of hills & uphill ✓

#6 TRIBS BETWEEN WATERS "C & E"

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site: Imperial Project
Applicant/Owner: Chemgold
Investigator: JP/JR

Date: 10/9/94
County: Imperial
State: CA

Do Normal Circumstances exist on the site? (Yes) No
Is the site significantly disturbed (Atypical Situation)? Yes No
Is the area a potential Problem Area? Yes No
(If needed, explain on reverse.)

Community ID:
Transect ID: Tributaries
Plot ID: btwn "C" & "E"

* = Dominants

VEGETATION

Dominant Plant Species	Stratum	Indicator
1. Gutierrezia sarothrae	T1, T6	
2. Ambrosia dumosa	T1 *T4 *T5 *T6	
3. Encelia farinosa	*T1, *T5, *T4, T6, T7	
4. Opuntia acanthocarpa	T1, T6, T7	
5. Krameria erecta	T1, T4, T6, T8	
6. Larrea tridentata	T1, T5, T4, T6, T7	
7. Chamaesyce albomarginata	T1, T6, T7	
8. Eriogonum inflatum	T1	
9. Opuntia bigelovii	T1	
10. Calliandra eriophylla	*T1 T5 *T6, T7, *T8	
11. Fouquieria splendens	T1 T4, T5, T6, T7, T8	
12. Dalea emoryi	T1, T6, T7, T8	
13. Hilaria rigida	*T1, T6, T8	
14. Cercidium floridum	T1, T6	
15. Opuntia ramosissima	T6	
16. Shrub w/ Pubescent leaf	T6	

Percent of Dominant Species that are OBL, FACW or FAC (excluding FAC-).

Remarks:

HYDROLOGY

___ Recorded Data (Describe in Remarks):
- ___ Stream, Lake, or Tide Gauge
- ✓ Aerial Photographs
- ___ Other

___ No Recorded Data Available

Field Observations:

Depth of Surface Water: _____ (in.)

Depth to Free Water in Pit: _____ (in.)

Depth to Saturated Soil: _____ (in.)

Wetland Hydrology Indicators:

Primary Indicators:
- ___ Inundated
- ___ Saturated in Upper 12 Inches
- ✓ Water Marks
- ✓ Drift Lines
- ✓ Sediment Deposits
- ___ Drainage Patterns in Wetlands

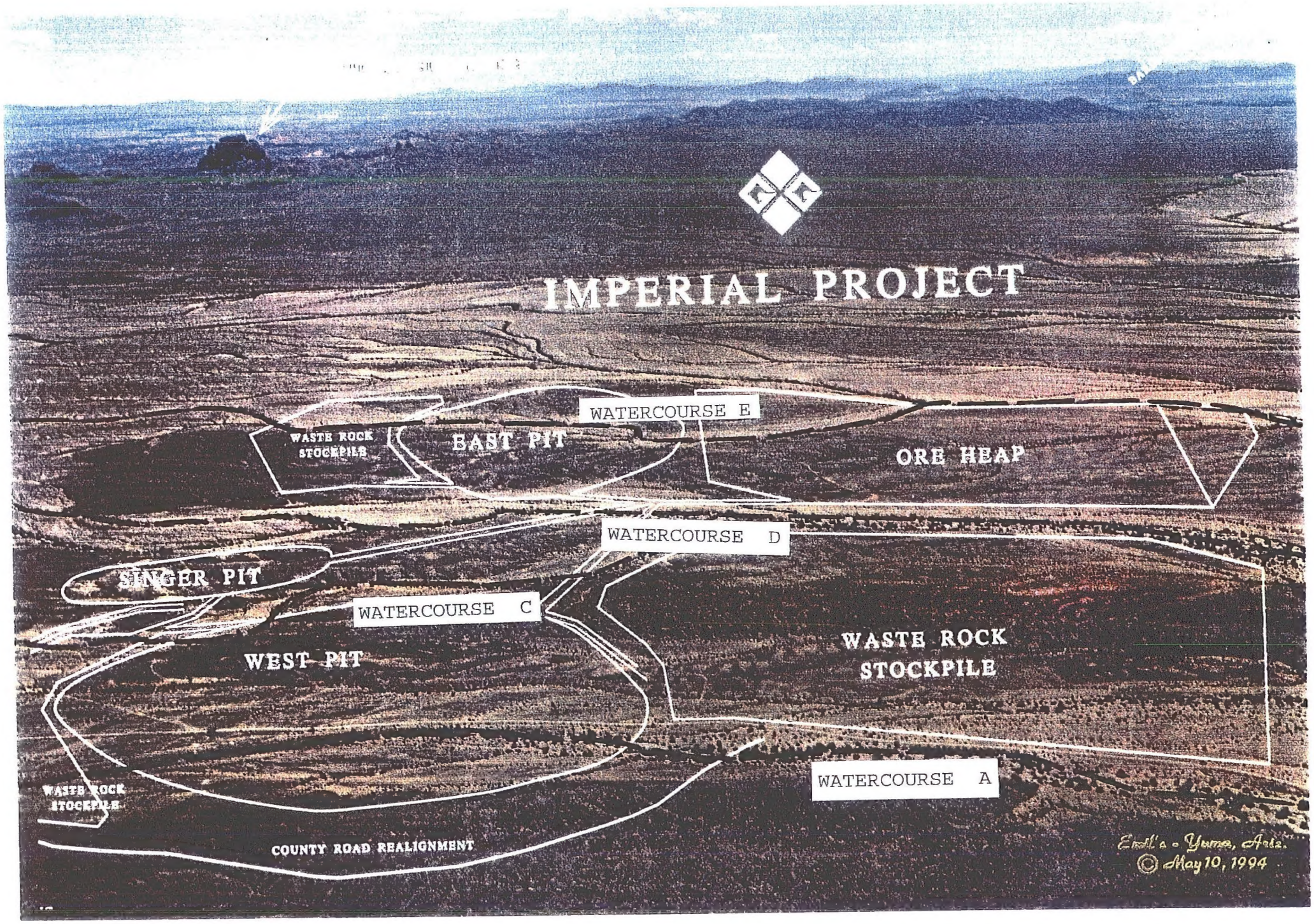
Secondary Indicators (2 or more required):
- ___ Oxidized Root Channels in Upper 12 Inches
- ___ Water-Stained Leaves
- ___ Local Soil Survey Data
- ___ FAC-Neutral Test
- ___ Other (Explain in Remarks)

Remarks:

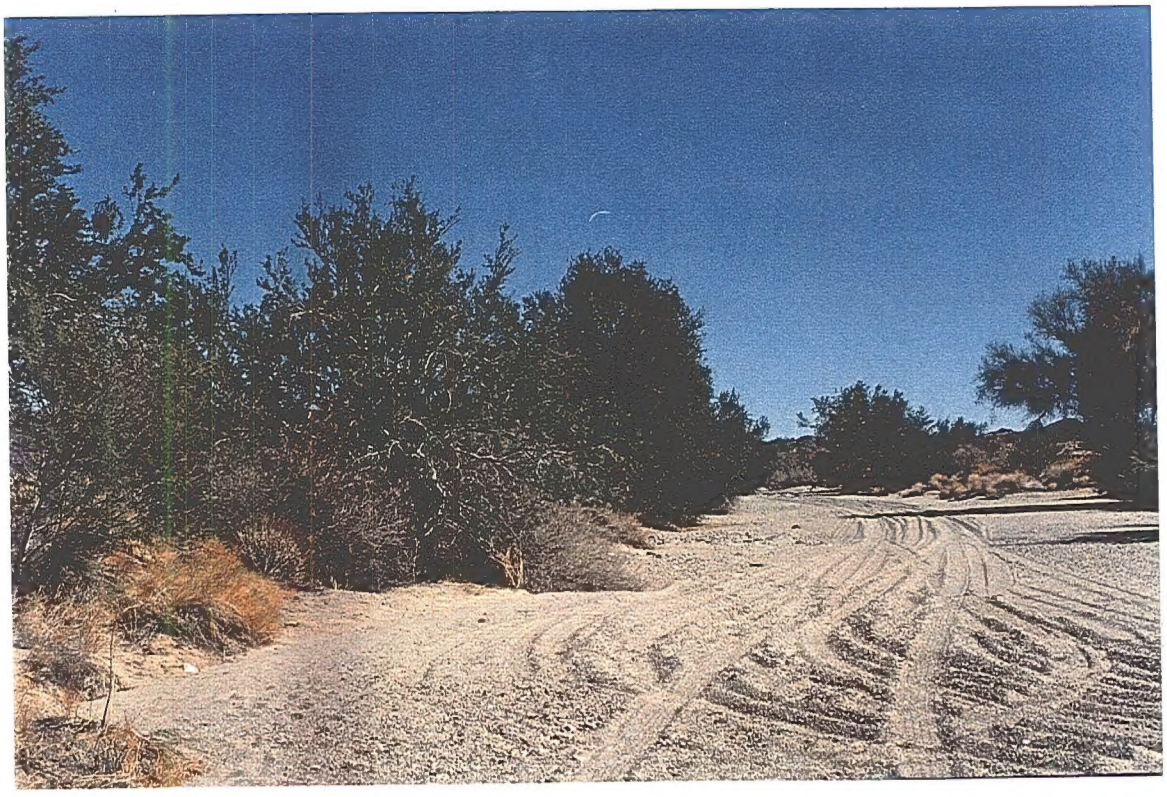
Roll #4
Photo # 20 ET 1 - upstream ✓
21 ET 6 downstream w/ topography ✓
22, 23, 24 ET 8 upstream & view of Picacho, overview of T8 looking upstream

APPENDIX B

PHOTOGRAPHS


IMPERIAL PROJECT
WASTE ROCK STOCKPILE
EAST PIT
WATERCOURSE E
ORE HEAP
WATERCOURSE D
SINGER PIT
WATERCOURSE C
WEST PIT
WASTE ROCK STOCKPILE
WASTE ROCK STOCKPILE
COUNTY ROAD REALIGNMENT
WATERCOURSE A
Ensl'a - Yuma, Ariz.
© May 10, 1994

APPENDIX B
WATERCOURSE PHOTOGRAPHS



Watercourse A-M6 - Upstream



Watercourse A-M6 - Downstream

APPENDIX B
WATERCOURSE PHOTOGRAPHS



Watercourse B-M4 - Upstream



Watercourse B-M4 - Downstream

APPENDIX B
WATERCOURSE PHOTOGRAPHS



Watercourse C-M4 - Upstream



Watercourse C-M4 - Downstream

APPENDIX B
WATERCOURSE PHOTOGRAPHS



Watercourse D-M1 - Upstream



Watercourse D-M1 - Downstream

APPENDIX B
WATERCOURSE PHOTOGRAPHS



Watercourse E-M7 - Upstream



Watercourse E-M4 - Upstream

APPENDIX C

WATERCOURSE PLANT SPECIES LIST

APPENDIX C
WATERCOURSE PLANT SPECIES LIST

Common Name	Scientific Name	Watercourse	Indicator Status[1]
Cat-claw	*Acacia greggii*	A-T1,C,E	FACU
Burrobrush	*Ambrosia dumosa*	A,A-T1,C,D,E	N/I - UPL
Fairy duster	*Calliandra eriophylla*	A,A-T1,C,D,E	N/I - UPL
Palo verde	*Cercidium floridum*	A,T-1,C,D,E,	N/I - UPL
Pincushion flower	*Chaenactis sp.*	A-T1	N/I - UPL
Rattlesnake spurge	*Chamaesyce albomarginata*	A,A-T1,C,D,E	N/I - UPL
Rigid spiney-herb	*Chorizanthe rigida*	A-T1	N/I - UPL
Forget-me-not	*Cryptantha sp.*	A-T1,D	N/I - UPL
Dodder	*Cuscuta sp.*	C	N/I - UPL
Brittle-bush	*Encelia farinosa*	A,A-T1,C,D,E	N/I - UPL
Desert trumpet	*Eriogonum inflatum*	E	N/I - UPL
Fluffgrass	*Erioneuron pulchella*	A	N/I - UPL
California barrel cactus	*Ferocactus cylindriceus*	C,D,E	N/I - UPL
Ocotillo	*Fouquieria splendens*	A-T1,C,D,E	N/I - UPL
Matchweed	*Gutierrezia sarothrae*	C,E	N/I - UPL
Yellow felt-plant	*Horsfordia newberryi*	A	N/I - UPL
Cheesebush	*Hymenoclea salsola*	A-T1,C,E	N/I - UPL
Desert lavender	*Hyptis emoryi*	A,A-T1,C,D,E	N/I - UPL
Purple heather	*Krameria erecta*	C,D,E	N/I - UPL
Creosote bush	*Larrea tridentata*	A,A-T1,C,D,E	N/I - UPL
Peppergrass	*Lepidium lasiocarpum*	A-T1	N/I - UPL
Anderson thornbush	*Lycium andersonii*	A,A-T1,C,D,E	N/I - UPL
Corkseed cactus	*Mammalaria tetrancistra*	A,	N/I - UPL
Desert tobacco	*Nicotiana obtusifolia*	A,A-T1	N/I - UPL
Desert ironwood	*Olneya tesota*	A,A-T1,C,D,E	N/I - UPL
Golden cholla	*Opuntia acanthicarpa*	A,A-T1,C,D,E	N/I - UPL
Beavertail cactus	*Opuntia basilaris*	A,A-T1,C,D,E	N/I - UPL
Bigelow cholla	*Opuntia bigelovii*	A,A-T1,E	N/I - UPL
Big galleta grass	*Pleuraphis rigida*	A,C,D,E	N/I - UPL
Jojoba	*Simmondsia californica*	A-T1,C,D,	N/I - UPL

1 USFWS, 1988; Biological Report, National List of Plane Species that Occur in Wetlands: Nevada.

N/I - Not listed as a national indicator, assumed to be obligate upland plants (OBL).

APPENDIX E-1 - HYDROLOGY BASELINE REPORT FOR THE IMPERIAL PROJECT, IMPERIAL COUNTY, CALIFORNIA

HYDROLOGY BASELINE REPORT
FOR THE
IMPERIAL PROJECT

IMPERIAL COUNTY, CALIFORNIA

Prepared for:

Chemgold, Inc.
1891 Rail Avenue
Yuma, Arizona 85365

Prepared by:

WESTEC Project 95145
Report 1451

February 1996

TABLE OF CONTENTS

1.0 INTRODUCTION 1
1.1 BACKGROUND 1
1.2 MINING HISTORY 2

2.0 GEOLOGY 3
2.1 REGIONAL GEOLOGIC SETTING 3
2.2 SITE GEOLOGY 3
2.2.1 Lithology 3
2.2.2 Structure 4

3.0 HYDROLOGY 5
3.1 REGIONAL SURFACE WATER 5
3.2 SITE SURFACE WATER 6

4.0 HYDROGEOLOGY 7
4.1 REGIONAL HYDROGEOLOGY 7
4.2 REGIONAL WELLS 8
4.3 SITE HYDROGEOLOGY 11
4.3.1 Aquifer Testing 12
4.3.2 Alluvial Aquifer 13
4.3.3 Bedrock Aquifer 14
4.3.4 Pit Inflow 16

5.0 WELL INSTALLATIONS 18
5.1 MONITORING WELL 18
5.2 PIEZOMETER WELLS 18
5.3 WATER SUPPLY TEST WELL 19

6.0 MINE SITE WATER SUPPLY 20
6.1 PUMP TEST 20
6.2 EVALUATION OF GROUNDWATER USAGE 21

7.0 WATER CHEMISTRY 24
7.1 REGIONAL WATER CHEMISTRY 24
7.2 SITE WATER CHEMISTRY 27

8.0 SUMMARY 30

9.0 RECOMMENDATIONS 34

10.0 REFERENCES 35

LIST OF TABLES, FIGURES, AND APPENDICES

TABLES

TABLE 4.1	Imperial Valley Groundwater Wells	10
TABLE 4.2	Alluvial Piezometer and Monitoring Well Data	14
TABLE 4.3	Bedrock Piezometer Well Data	15
TABLE 4.4	Slug and Falling Head Test Data for Bedrock Piezometers	16
TABLE 4.5	Pit Inflow/Outflow Calculations	17
TABLE 6.1	Drawdown After 20 Years	22
TABLE 6.2	Drawdown in Gold Rock Ranch, Mesquite Mine, and American Girl Mine Wells	22
TABLE 7.1	Regional Water Chemistry Analyses	25
TABLE 7.2	Site Water Chemistry Analyses	28

FIGURES

FIGURE 1-1	Location Map
FIGURE 1-2	Site Facilities Layout
FIGURE 2-1	Regional Geology Map
FIGURE 2-2	Site Geology - Cross Section
FIGURE 3-1	Regional Hydrographic Basin
FIGURE 4-1	Regional Hydrogeologic Basins
FIGURE 4-2	Regional Well Locations
FIGURE 4-3	Site Piezometers / Monitoring Wells / Production Wells and Gold Rock Ranch Locations
FIGURE 4-4	Cross Section A-A[1]
FIGURE 5-1	Monitoring Well Design
FIGURE 5-2	Production Well Design
FIGURE 6-1	Radius of Influence
FIGURE 7-1	Stiff and Piper Diagrams

APPENDICES

APPENDIX A	Falling Head / Slug Test Data
APPENDIX B	Pit Inflow Calculations
APPENDIX C	Well Installations
APPENDIX D	Geologic Logs for Piezometer, Monitoring Well, and Production Well
APPENDIX E	Pump Test Field Data and Calculations
APPENDIX F	Water Quality Analyses

1.0 INTRODUCTION

1.1 BACKGROUND

Chemgold, Inc. (CHEMGOLD) proposes to develop a precious metals mining operation, the Imperial Project, in Imperial County, California. The proposed mine and process area will be located within the Colorado Desert portion of the Basin and Range physiographic province along the southwestern flank of the Chocolate Mountains in southeast California (Figure 1-1). Project development will include excavation of two open pits, the East and the West Pit. A third, smaller open pit, the Singer Pit, may be located between the East and West Pits. A waste rock stockpile, a heap leach pad, solution collection ponds, solution processing facilities, and other ancillary facilities will be constructed southwest of the open pits as shown in Figure 1-2. The estimated annual project water requirement is approximately 1,170 acre-feet of groundwater. This equates to an average of 725 gallons per minute (gpm) for an operational life of up to 20 years. Peak demand is estimated to be about 1,000 gpm for short periods of time.

CHEMGOLD retained WESTEC, Inc. (WESTEC) to assess the local hydrogeological characteristics including delineating the groundwater flow conditions and water chemistry in the mine project area. The study consisted of review of the existing and published information, compilation of project related hydrogeologic information, well design and construction, calculations of well yields, and evaluation of long-term water pumping on surrounding groundwater resources.

This report characterizes the hydrogeology of the project area. This area includes the mine site and processing facilities located southwest of Indian Pass on the pediment slopes of the Chocolate Mountains, and the alluvial basin area located southwest of the Chocolate Mountains and northwest of the Cargo Muchacho Mountains. The primary purpose of the study was to evaluate the existing hydrogeologic conditions of the mine project area. The issues addressed during this study included:

- Evaluation of existing groundwater flow conditions and recommend placement of groundwater quality monitoring wells.
- Evaluation of surrounding groundwater resources to supply estimated mine project water requirements, and recommendation of placement of groundwater supply wells.
- Estimation of pit water inflow encountered during mining operations.

1.2 MINING HISTORY

The Imperial Project is located on the eastern border of the Imperial Valley on the southern flank of the Chocolate Mountains in southeastern California. The first gold mining in the region is attributed to early Spanish communities in the Cargo Muchacho Mountains in the late 1700's. After the Mexican War in 1848 and with the advent of the California Gold Rush in 1849, mining interest in the region increased, coming to a peak between 1870 and 1930. Production from nearby mines at Picacho, Tumco, and American Girl peaked in the early 1900's, producing a cumulative total of approximately 500,000 ounces of gold. Scattered, small-scale dry wash placer operations were attempted throughout the region and many small tailings piles from these operations are still visible. Advances in heap leaching technology in the 1970's and an increase in gold prices led to exploration and subsequent development of open pits at the Picacho mine in 1979, and the Mesquite and American Girl mines in 1980 (Environmental Management Associates (EMA), 1996).

Little recorded mining history exists for the project area itself. Near the north-central project boundary, bedrock exposed in several of the dry washes was first prospected by Dick and Alice Singer. Between 1982 and 1985, Gold Fields Mining Corporation conducted a regional geophysical exploration program consisting of aeromagnetic, gravity, and resistivity surveys and stream wash geochemical studies. Gravity anomalies, low-grade mineralization in exposed bedrock, and a limited drilling program led to the discovery of minor mineralization on the margins of the current Imperial Project (EMA, 1996).

In 1987, Glamis Gold Exploration, Inc. (GGX) acquired the property and began exploration drilling through a joint venture agreement with a third party. In 1994, GGX became the sole owner and operator of the property and initiated an accelerated development drilling and pre-feasibility program. This program ultimately culminated in the delineation of three ore bodies designated by the proposed East, Singer, and West Pits. Continued exploration drilling between the proposed open pits may ultimately discover additional mineral reserves (EMA, 1996).

2.0 GEOLOGY

2.1 REGIONAL GEOLOGIC SETTING

The Imperial Project ore deposit is located on the southern flank of the Chocolate Mountains, structurally aligned and equidistant between the Picacho and Mesquite deposits. All three of these deposits are situated in the upper plate of the late Mesozoic Chocolate Mountains thrust (Liebler, 1988; Willis, 1988). The Chocolate Mountains thrust is a member of the Vincent-Orocopia-Chocolate Mountains thrust system which can be traced across southern California and southwestern Arizona (Willis, 1988). All of these thrusts have transported gneissic and intrusive rocks over greenschist facies Pelona and Orocopia schists. Movement of the upper plate of the Chocolate Mountains thrust is believed to be at least 48 kilometers (30 miles) northeastward, occurring during latest Mesozoic. Upper plate rocks consist of gneisses and multiple episodes of plutonic intrusion. These rocks were subjected to several phases of amphibolite facies regional metamorphism (Willis, 1988).

The areal geology consists of Jurassic age upper plate metamorphic rocks, overlain by Tertiary andesite-basalt flows, fanglomerates, and Quaternary alluvium. A thin veneer of flood basalt caps the gravel and alluvium, forming distinct ridges and pediment landforms (Figure 2-1). The project area is topographically situated between 700 and 900 feet above mean sea level (amsl), on nearly flat terrain. The region is characterized by gravel pediments cut by south trending ephemeral washes.

2.2 SITE GEOLOGY

2.2.1 Lithology

The generalized stratigraphic sequence consists of Jurassic gneisses and schists overlain by Tertiary and Quaternary gravels. The Imperial Project stratigraphic section has been cut by a low angle thrust sheet, and in general the mineralization parallels the thrust sheet. The footwall or the lowermost unit that will be exposed during mining activities is a Jurassic undifferentiated metamorphic which form the footwall to the orebody (Figure 2-2).

Generally above the undifferentiated gneisses which has sericitic schist zones that appear to be structurally and/or hydrothermally localized. Biotite gneiss varies from a white quartzo-

feldspathic rock to a dark gray hornblende-biotite gneiss. Often the biotite gneiss has a shatter breccia texture that is variably cemented by iron oxides, clays and, less commonly, quartz or carbonate. The sericitic schist is a white, red to tan iron oxide stained rock composed predominantly of sericite with minor quartz. Due to the oxidized state exhibited throughout the deposit, no fresh pyrite or sulfide mineralization has been detected in core samples or drill hole cuttings.

Tertiary conglomerate and Quaternary gravels overlie the Jurassic metamorphics. The conglomerate is typically a moderately well indurated, clay, carbonate and iron oxide cemented material with coarse subangular gneissic fragments in a moderate to coarse grained sand matrix with considerable mica component. Conglomerates and alluvium cover 95 percent of the project area and range in thickness from 10 to 1,000 feet.

2.2.2 Structure

Dominant regional structural features include the Chocolate Mountains thrust fault, which placed basal gneissic rocks over the younger Orocopia Schist, and the San Andreas fault system. The Chocolate Mountain thrust is part of the Vincent-Orocopia-Chocolate Mountain thrust system which can be traced through southeastern California and southwestern Arizona. The upper plate rocks, consisting of amphibolite grade gneisses and granitic gneisses, have been thrust at least 30 miles northeastward over the greenschist facies Pelona and Orocopia schists. These rocks form a northwest-trending antiform structure within the Chocolate Mountains. Regional structural events have created detachment fault features at the Picacho and American Girl Mines, and intricate strike-slip fault systems at the Mesquite Mine.

The dominant structural feature in the project area is a west-northwest trending thrust sheet that moved Jurassic gneisses and schists over metamorphic and sedimentary rock units. The thrust sheet appears as a network of curved faults (flower faults) which dip approximately 30 degrees to the south. High angle, east-west striking normal faults (step faults) drop the stratigraphy to the south. High angle, north to northeast trending faults bound the mineralized zones, forming the east and west economic limits. The full extent of these north-trending faults is not yet well understood.

3.0 HYDROLOGY

3.1 REGIONAL SURFACE WATER

The Imperial Project is located within the Salton Sea Drainage Basin, a closed hydrologic basin in which all surface flows drain toward the Salton Sea, a saline water body which has no outlet (Figure 3-1). The Algodones Sand Dunes, a natural topographic constraint located approximately 12 miles topographically downgradient from the project to the southwest, prevents any surface water which flows from or through the project area from reaching the Salton Sea (EMA, 1996). Surface flows either evaporate or infiltrate into the wash bottoms or outwash areas east of the Algodones Sand Dunes. There are no free-standing surface waters within the Imperial Project area or in the immediate vicinity.

Precipitation in the project area is limited. Annual rainfall ranges from less than 5 inches per year on the valley floor and alluvial slopes to 5.5 inches in the mountains. Evaporation rates in the project area are estimated to be about 100 inches per year (Environmental Solutions, Inc., 1993). The region's low precipitation rate, coupled with the high evaporation rate and the presence of highly permeable soils in the washes, precludes the formation of perennial or intermittent steams and results in limited recharge of the groundwater reservoir by infiltration of waters of meteoric origin.

In the project area, the valley floor slopes in a southwesterly direction from an elevation of approximately 900 feet near Indian Pass to 600 feet near the intersection of Indian Pass Road and Ogilby Road. The ground surface is relatively even except for occasional northeast-southwest oriented washes. Vegetation in the project area is typically Sonoran. Accumulations of phreatophyte-type vegetation are not evident, indicating that shallow supplies of groundwater are not present (EMA, 1996).

The Colorado River, located approximately 7 miles northeast of the project at its closest point, represents the closest perennial surface water source (EMA, 1996). However, the Colorado River is located on the north-northeastern side of the Chocolate Mountains and does not flow into the Salton Sea Drainage Basin. Perennial water distribution systems within the Salton Sea Drainage Basin which are within the vicinity of the Imperial Project are the All-American Canal

and the Coachella Canal. The All-American Canal, located approximately 16 miles to the south, transports water from the Colorado River and is the primary source of water within the Salton Sea Drainage Basin. The Coachella Canal, which is a branch of the All-American Canal, is located approximately 19 miles southwest of the project on the other side of the Algodones Sand Dunes (EMA, 1996).

3.2 SITE SURFACE WATER

Surface water drainages within the Imperial Project consist of a series of subparallel ephemeral washes which are fed by precipitation from infrequent winter storms and summer thunderstorms. No springs or seeps or perennial surface water flows have been identified in the project area.

4.0 HYDROGEOLOGY

4.1 REGIONAL HYDROGEOLOGY

The groundwater reservoir in the Imperial Valley consists of Cenozoic valley-fill deposits underlain by a basement complex of pre-Tertiary rocks. The hydrogeologic unit underlying eastern Imperial Valley is comprised of the Amos, Ogilby and East Mesa hydrogeologic areas (see Figure 4-1). The California Department of Water Resources incorporated both the Amos and Ogilby basins into one combined Amos/Ogilby hdrologic unit (California Department of Public Works, 1964). The East Mesa and Amos/Ogilby basins have a combined overall size of approximately 860 square miles within Imperial County. However, pervious alluvium containing the stored groundwater extends for hundreds of additional square miles southward into Mexico. The much finer-grained sediments in the agricultural portion of Imperial County form the western edge of the basin. Within the Amos/Ogilby and East Mesa hydrologic basins, the thickness of the pervious alluvium varies from east to west, extending from a relatively thin layer of 10 feet or less near the Chocolate Mountain front to a maximum reported depth of approximately 10,000 feet toward the center of the valley to the west (Loeltz, 1975).

The Imperial Project lies within the Ogilby Valley Basin which is a northwesterly trending, elongated area of about 220 square miles which lies in the southeastern portion of Imperial County, California (Department of Water Resources, 1975). It is bounded on the northeast by the Chocolate Mountains, on the north by the divide which separates the Ogilby Basin from the Amos Basin, and on the southwest by the Algodones Sand Dunes. The Cargo Muchacho Mountains and Pilot Knob near the United States-Mexico border are situated on the south end of the basin. The Amos Valley Basin is also northwesterly trending, about 220 square miles and lies in the eastern portion of Imperial Valley. It is bounded on the northeast by the Chocolate Mountains, on the north by the East Salton Sea Basin, to the southwest by the East Mesa hydrologic area and to the southeast by the Ogilby Basin. Although the Ogilby Basin is sometimes considered separate from the adjacent Amos Basin to the north, the California Department of Public Works (1964) has incorporated both the Amos and Ogilby basins as the Amos/Ogilby Hydrologic Unit due to similarities in geologic and hydrologic characteristics.

Data from the USGS (Dutcher et al., 1972 and Loetz, et al, 1975) has suggested that the Amos/Ogilby basins may be hydraulically continuous with the East Mesa subbasin. The East Mesa area, located on the west-southwestern side of the Algodones Sand Dunes, is a large alluvial area which receives a significant amount of recharge from the Colorado River and All-American Canal. The combined extent of the East Mesa hydrolgraphic area and the Amos/Ogilby basins is approximately 860 square miles.

The Amos/Ogilby Basin has not been included as part of the Colorado River Aquifer System based on information published by the USGS (Wilson, 1994). The bedrock associated with the Chocolate Mountains acts as a hydrologic divide preventing movement of water between the Colorado River located on the eastern side of the mountain range and the Amos/Ogilby Basin located on the western slopes of the Chocolate Mountains.

The USGS (Dutcher, 1975) has estimated that the storage capacity of usable and recoverable water in the Amos/Ogilby Basin is approximately 126,000,000 acre-feet, and the capacity of East Mesa subunit is approximately 103,000,000 acre-feet. Estimated annual recharge to the East Mesa, and Amos/Ogilby areas due to all sources is 100,000 acre feet (Environmental Solutions, Inc., 1993).

4.2 REGIONAL WELLS

The availability of surface water from irrigation canals and the low density land use in eastern Imperial County has resulted in very little groundwater usage. Groundwater has been extracted from the Mexican portion of the alluvial aquifer for agricultural purposes, but the portion of this agricultural water which reinfiltrates back to the groundwater is not known (Loeltz, 1975).

Information on the historic use of groundwater in the vicinity of the project area is limited. The earliest documented usage of water was the importation of water for local use in Glamis by the Southern Pacific Railroad. The earliest documented construction of a well in the eastern Imperial Valley was the Gold Rock Ranch well in 1935, to a total depth of 521 feet, to provide water for domestic use by local residents. The Gold Rock Ranch well, located approximately 4.5 miles southwest of the proposed Imperial Project well field, is the closest water supply well to the project site. The Gold Rock Ranch well is reported to have been pumped at a continuous rate of 150 gallons per minute for two years to provide water for the Glamis-Ogilby Road construction (Fox, 1984).

In 1937, the Vista Mine Well was constructed to a total depth of 690 feet. The well, which was reported to have a yield of 800 gallons per minute, provided water for mining operations in the area at that time. In 1984, Wells GF1, GF2 and GF3A were completed in close proximity to the original Vista Mine Well. During a continuous 120-hour pump test, Well GF1 discharge was measured at 2000 gpm with a drawdown of 40 feet below the static water level (Fox, 1984). Other wells within the vicinity of the Imperial Project are the production wells at the Mesquite Mine and American Girl Mine, as shown in Figure 4-2. Both of these wells were completed in the Amos/Ogilby Basin alluvium.

More recent use of groundwater in eastern Imperial Valley occurred in 1972 when the Glamis Well was constructed to a total depth of 681 feet. This well, reported to have a yield of 300 gallons per minute with 73 feet of drawdown, was constructed for domestic use. Two additional deep wells were constructed on the western side of southern Imperial Valley. The United States Bureau of Reclamation constructed a well in the southwest part of the basin to evaluate the feasibility of constructing a desalinization disposal facility. The other well, which was to supply groundwater for the Mining Management Company, was constructed in 1980 to a total depth of 735 feet. Due to a partially collapsed well casing, this well has never been fully developed (Fox, 1984). A summary of information on groundwater wells in the southern part of the Imperial Valley basin is presented in Table 4.1.

Current estimated groundwater pumping from the wells in the Amos/Ogilby basin is approximately 1700 acre-feet per year. This includes an annual withdrawal of approximately 1500 acre-feet per year from the Mesquite Mine, approximately 6 acre-feet per year from Gold Rock Ranch, and approximately 200 acre-feet per year from the American Girl Mine (Environmental Solutions, 1993; P.M. DeDyker & Associates, 1994) . This estimate does not include the Glamis or the Boardman wells.

TABLE 4.1
IMPERIAL VALLEY GROUNDWATER WELLS

WELL IDENTIFICATION	PURPOSE	RATED YIELD (gpm)	TOTAL DEPTH (ft)	PERFORATED INTERVAL (ft)	SEALED DEPTH (ft)	DATE COMPLETED	APPROXIMATE WATER LEVEL (ft)	
							DEPTH	ELEVATION
WT - 2	Production/ Monitoring	28	442	154 - 404	n/a	10/82	185	550
SM - 63	Production	10	477	n/a	n/a	n/a	185	575
SM - 241	Production	10	520	n/a	n/a	n/a	200	560
Singer Well	Production	15	470	n/a	n/a	n/a	220	575
GW - 1	Monitoring	<15	430	317 - 416	0 - 291	10/85	313	277
GW - 2	Monitoring	<10	310	207 - 305	0 - 190	10/85	270	360
GW - 3	Monitoring	1 - 2	310	196 - 296	0 - 193	10/85	213	437
GW - 4	Monitoring	2	320	209 - 309	0 - 190	10/86	223	502
GW - 5	Monitoring	2	359	259 - 359	0 - 250	10/88	270	n/a
GW - 6	Monitoring	1 - 2	338	238 - 338	0 - 222	01/90	250	n/a
MCR - 80	Production*	<26	1,017	402 - 1,002	0 - 50	03/83	197	523
GF - 1	Production	3,000 - 6,000	822	506 - 810	0 - 20	12/83	474	79
GF - 2	Production	2,300 +	908	658 - 885	0 - 50	03/85	462	78
GF - 3A	Production	2,250+	940	690 - 930	0 - 50	03/86	469	77
MBH - 1	Observation	n/a	600	510 - 590	0 - 300	11/84	467	81
MBH - 2	Observation	n/a	640	510 - 630	0 - 400	11/84	470	80
MBH - 3	Observation	n/a	683	510 - 680	0 - 400	11/84	458	79
Boardman Well	Production	n/a	735	n/a	n/a	1980	309	95
Glamis Well	Production	300	520	n/a	n/a	1972	235	100
Gold Rock Ranch Well	Production	n/a	521	n/a	n/a	1935	397	83
American Girl Mine 26 - 1	Production	50	n/a	n/a	n/a	n/a	280	119
American Girl Mine 26 - 2	Production	400	393	n/a	n/a	8/88	280	119

Source: Hydrologic Assessment Report Mesquite Regional Landfill

Production* = Intended for Large Scale Production, but Insufficient Yield

n/a = Not Available

4.3 SITE HYDROGEOLOGY

Groundwater occurs within three aquifers underlying the project area, a confined alluvial aquifer, an unconfined alluvial aquifer, and a bedrock aquifer. The alluvial aquifers consist of consolidated and unconsolidated sands and gravels, while the bedrock aquifer is comprised of metamorphic rocks. Infiltration and water movement in the alluvial sediments is rapid and, consequently, they are considered a better aquifer source than the bedrock aquifer.

Groundwater flow within the project area is primarily from the higher elevations of the Chocolate Mountains toward the southwest to the alluvial basin in the valley. The general groundwater gradient is northeast to southwest, which corresponds to the low relief pediment surface extending in a southwestward direction from the foot of the Chocolate Mountains (western side) toward the alluvial basin (Loeltz, 1975). Water table contours generally parallel the range front. Groundwater movement in the alluvial deposits in the valley occurs in a south-southwest direction.

The alluvial and bedrock aquifers were characterized during the site hydrogeological investigation by installing a combination of piezometer, monitoring wells, and a test production well. Collected data was utilized to determine static groundwater elevations, to evaluate the water chemistry, and to estimate the in situ aquifer hydraulic properties associated with each aquifer system. The production test well was installed 4.5 miles southwest of the proposed mine processing facilities to define aquifer hydrologic parameters and to evaluate the groundwater supply to meet anticipated project water requirements. Figure 4-3 shows the locations of the piezometers, monitoring well, and production test well at the Imperial Project site. The construction and installation of these wells are described in Section 5.0.

As stated above, three different aquifers occur in the project site; a unconfined alluvial aquifer, a confined alluvial aquifer and a bedrock aquifer. An unconfined aquifer has a free water table, so that the water in the aquifer is not under pressure beneath impermeable beds. A confined aquifer is bound above and below by impermeable beds, therefore the water in the aquifer is under pressure greater than atmospheric.

Figure 4-3 shows static groundwater elevations ranging from a high of 360 feet at MW-1, just northeast of the mine site, to a lower elevation near well H-3 of 70.5 feet, and a higher elevation near well H-5 of 85 feet msl. WESTEC believes that this difference in static water levels is due to the wells being completed in the different aquifers.

The wells near the mine site, H-1, H-3, ER-2, WR-2, WR-31,and MW-1, are all completed; an unconfined alluvial aquifer and mine site wells EC-5, WC-5, and WR-1 have been completed in the bedrock aquifer. The wells installed approximately 4 miles southeast of the mine site, wells PW-1, H-4, H-5, and H-6, are completed in confined aquifers which are not hydrologically connected to the aquifers at the mine site. Figure 4-4 is a cross section through the project site showing well and piezometer locations with the screened intervals of each well and static water level elevations. The screened intervals in wells H-4, H-5, and H-6 are in deeper portions of the stratigraphic section than the screened intervals of the other wells. The geologic logs of well H-4 and H-6 indicate a confining layer of silt and clay in the alluvium above the screened intervals indicating the wells are completed in a confined alluvial aquifer. Well H-5 was completed in the bedrock, and it is likely that the bedrock above the screened section is also acting as a confining layer.

The groundwater flow direction in the unconfined alluvial aquifer near the mine site is toward the southwest, at a gradient of 0.02. The flow direction in the confined alluvial aquifer is presumed to be toward the southwest as well, although an additional well, completed in the lower aquifer, would be needed to confirm this.

4.3.1 Aquifer Testing

Three different methods of aquifer testing were performed at the project site; falling head tests, slug tests, and a constant rate pumping test. Each of these tests were used to evaluate the hydrogeologic characteristics of the geologic materials underlying the site.

Falling head and slug tests were performed in the piezometer wells to determine in situ aquifer hydraulic properties. Both tests were performed in the piezometers located in the bedrock. Falling head tests could not be performed in the alluvial piezometers because the increased permeability of the alluvial materials would not allow a sufficient column of water be maintained in the well during the tests. Each falling head test involved filling the piezometer with water to the top of the casing and recording the water level drop over timed intervals.

Each slug test involved lowering a polyvinyl chloride (PVC) slug of known volume into a well and submerging it below the static water level, causing an instantaneous change in the water level. The water level in the well was measured prior to the time that the slug was lowered. Water levels in the well were measured at timed intervals as the water column recovered to the original

static water level. Water levels were recorded using a pressure transducer, submerged in the piezometric well, with automatic electronic signal recording equipment. The field-measured data from the falling head and slug tests (water level in the well vs. time) and piezometer well geometry (screen, filter pack, well, and casing dimensions) were used to determine hydraulic conductivity values using the Hvorslev technique. Test results, aquifer parameters and well information are presented in the following sections.

A constant rate pump and recovery test was performed in the production test well to determine the transmissivity and storage coefficient of the alluvial sediments within the vicinity of the well. The pump and recovery test will be explained in more detail in Section 7.1. Aquifer hydrological parameters determined from the tests were used to evaluate the potential impact to the alluvial aquifer system from groundwater withdrawal during projected mining operations at the Imperial Project.

4.3.2 Alluvial Aquifer

In the project area, the alluvial deposits derived from the Chocolate Mountains provide the greatest source of groundwater. Near the mountain front, these deposits are relatively thin, but thicken rapidly toward the valley floor to the southwest. The alluvial deposits in the project range from 10 feet to over 1,000 feet and thicken toward the Imperial Valley.

Information about the piezometers and monitoring well installed in the alluvial deposits is summarized in Table 4.2. Well MW-1 refers to the monitoring well installed upgradient (to the north) in the area between the proposed East and West pits. The H-series wells listed in the table are piezometers located southwest of the project site in the alluvial valley basin. Piezometer well WR-31 is installed in the alluvial sediments underlying the proposed waste rock dump area, and well ER-2 is a piezometer installed in the alluvium south of the east pit (see Figure 4.3).

TABLE 4.2
ALLUVIAL PIEZOMETER AND MONITORING WELL DATA

HOLE NUMBER	DATE MONITORED	TOTAL DEPTH (feet bgs)	SURVEYED COLLAR ELEVATION (feet amsl)	DEPTH TO WATER (feet bgs)	STATIC WATER ELEVATION (feet amsl)
H - 1	1/03/96	1,000	736	657.2	78.8
H - 3	1/03/96	1,100	765	694.5	70.5
H - 4	1/03/96	1,000	617	544.6	72.4
H - 6	12/95	920	710[1]	631.5	78.5
WR - 2	1/03/96	945	765	694.5	70.5
WR - 31	1/03/96	900	774	682.5	91.5
ER - 2	1/03/96	930	787	682.5	104.5
MW #1	1/03/96	640	840	479.7	360.3

[1] = Approximate Collar Elevation
n/a = Not Available

H-4 was the only well in the alluvium from which slug test results were interpretable. H-3 was also tested but the results were ambiguous. Well H-4 was completed in the confined alluvial aquifer. The slug test results for H-4 indicated a hydraulic conductivity of 2.8×10^{-2} cm/sec, which agrees well with a hydraulic conductivity value of 5.6×10^{-3} cm/sec (16 ft/day) obtained from the constant rate pumping and recovery test described in section 7.1.

4.3.3 Bedrock Aquifer

The bedrock in the project area is composed of gneissic and granitic rocks and except for rare occurrences of bedrock outcrop, most of the surface is covered by alluvium. In the bedrock, groundwater may be stored in the network of fractures and joints created by faulting. Although the system of fractures and joints is capable of high transmissivities, their localized occurrence limits the volume of water transmitted to wells. Furthermore, transmission capacities would be high if the fractures were highly interconnected. Because of the relatively small volume of water contained in the fracture system, it is doubtful that well yields exceeding 40 gpm could be sustained for more than a few years.

Table 4.3 summarizes the well data for the four piezometers installed in the bedrock aquifer. Piezometers installed in the proposed East Pit and West Pit are designated as EC-5 and WC-5, respectively. Piezometer H-5 is located approximately 12,000 feet southwest from the proposed mine processing facilities. Piezometer WR-1 is located on the southwest side of the East Pit.

TABLE 4.3
BEDROCK PIEZOMETER WELL DATA

HOLE NUMBER	TOTAL DEPTH (feet bgs)	SURVEYED COLLAR ELEVATION (feet amsl)	SCREENED INTERVAL (feet bgs)	DEPTH TO WATER (feet bgs)	STATIC WATER ELEVATION (feet amsl)
WC - 5	800	818	760 -800	606	211
EC - 5	800	807	760 - 800	720	88
H - 2[1]	1340	685	- - -	- - -	- - -
H - 5	1080	686	1,040 - 1,080	594.5	85.5
WR-1	910	821	open	734	87

[1] Well H-2 plugged.

The static water levels of 88 feet amsl in the East Pit and 211 feet amsl in the West Pit piezometers indicate that groundwater occurs at a much lower elevation in the East Pit. The difference may be the result of the fracture controlled nature of groundwater in the bedrock or due to unknown groundwater barriers created by faulting between the two pits.

The hydraulic conductivities corresponding to the falling head and slug tests conducted in the piezometers located in the East and West pits are shown in Table 4.4. The tests indicated that the bedrock formation has a very low hydraulic conductivity, on the order of 10^{-6} to 10^{-7} cm/sec (10^{-8} to 10^{-9} ft/sec). Falling head tests conducted in EC-5 and WC-5 show hydraulic conductivities of 3.5×10^{-7} to 1.4×10^{-6} cm/sec while the slug tests conducted in the same holes show hydraulic conductivities of 3.8×10^{-7} and 8.4×10^{-7} cm/sec, respectively. The slug test on Well H-5 indicates a hydraulic conductivity of 1.05×10^{-2} cm/sec. Although the well was screened in the bedrock, the geologic log indicates the bedrock is highly fractured in the screened interval. Reported hydraulic conductivity values for igneous and metamorphic rocks which form the site bedrock aquifer unit range from 10^{-2} cm/sec to less than 10^{-11} cm/sec, depending on the degree of fracturing present in the formation (Freeze and Cherry, 1979).

The field test data and hydraulic conductivity calculations for the falling head tests and slug tests are included in Appendix A.

TABLE 4.4
SLUG AND FALLING HEAD TEST DATA FOR BEDROCK PIEZOMETERS

HOLE NUMBER	TEST	HYDRAULIC CONDUCTIVITY		FORMATION
		cm/sec	ft/sec	
EC - 5	Slug	3.8×10^{-7}	1.2×10^{-8}	Bedrock
WC - 5	Slug	8.4×10^{-7}	2.7×10^{-8}	Bedrock
EC - 5	Falling Head	3.5×10^{-7}	1.1×10^{-8}	Bedrock
WC - 5	Falling Head	1.4×10^{-6}	4.6×10^{-8}	Bedrock
H - 5	Slug	1.05×10^{-2}	3.4×10^{-4}	Bedrock

4.3.4 Pit Inflow

Both the East and the West Pits will intersect groundwater during mining operations. It is anticipated mining will encounter groundwater at 100 and 200 feet amsl in the East and West Pits, respectively. An estimate for dewatering quantities was calculated for each pit using the Jacob-Lohman Equation. This equation can be used to provide preliminary estimates of natural groundwater inflow into a pit (Hanna et al., 1994). This equation assumes that the well fully penetrates an ideal confined aquifer that is infinite in areal extent and has uniform transmissivity and storativity. A more detailed description of the method used is included in Appendix B.

Using the current mine pit configuration the equation was used to obtain a estimate of groundwater inflow into each of the pits. The transmissivity and storage values were selected from the slug test data analysis; the drawdown value selected is the static groundwater elevation minus projected total pit depth. The radius of 800 feet was selected by measuring the diameter of the pit at the 200 foot level. The time factor of 100 days was selected to avoid factoring in the increased flow effects due to draining the bedrock aquifer to the base of the pit. Using these parameters, the estimated groundwater inflow contributed from the bedrock aquifer into the East and West pits after 100 days was calculated to be 300 ft^3/day (1.5 gpm) and 150 ft^3/day (0.7 gpm), respectively.

The estimate of the pit inflow rate does not include other factors such as runoff, direct precipitation, or evaporation. These three factors will affect the overall water balance within the pit-groundwater system. The magnitude of the effect of these three factors cannot be included within this simple calculation. However, runoff will be diverted away from the pit. Evaporation is approximately 100 inches per year, and should offset precipitation of approximately 5.5 inches per year and pit groundwater inflow.

TABLE 4.5
PIT INFLOW/OUTFLOW CALCULATIONS

INFLOW(+) or OUTFLOW (-)	EAST PIT (ft^3/yr)	WEST PIT (ft^3/yr)
Precipitation &Groundwater	$+1.0 \times 10^6$	$+9.4 \times 10^5$
Evaporation	-1.7×10^7	-9.4×10^6
Difference	-1.6×10^7	-8.45×10^6

Simple calculations assuming a pit lake area similar to the pit lake area used in the inflow calculations, radius of 800 feet with an evaporation rate of 100 inches/per year, yield a total evaporation of 1.7×10^7 ft^3/year for the East Pit, and 9.4×10^6 ft^3/year for the West pit. Pit inflow due to precipitation of 5.5 inches/yr and inflows of 1.6 gpm and 0.7 gpm for the East and West pits indicate total pit inflows of 1.0×10^6 and 9.4×10^5 ft^3/year for the East and West pits respectively. Each of these pit inflow estimates is approximately 10 percent of the estimated total evaporation for each pit, indicating that the formation of a pit lake is not probable (Table 4.5). Additionally, CHEMGOLD is planning to backfill the West Pit with overburden material from the East Pit mining.

5.0 WELL INSTALLATIONS

Three types of wells have been installed at the project: a monitoring well, a water level piezometer, and a water supply test well. A brief summarization of installation of each type is described below; a more detailed description of the installation is included in Appendix C.

5.1 MONITORING WELL

A monitoring well (MW-1) was drilled and installed by Harris Drilling Company and CHEMGOLD personnel using an air/mud rotary drilling rig. The monitoring well was installed upgradient of the proposed mine pit area and is shown in Figure 4.3.

A diagram of the monitoring well design is included as Figure 5.1. Monitoring well MW-1 was installed to a depth of 640 feet and was constructed with 1½-inch-diameter schedule 80 PVC pipe, with 60 feet of 0.04 slot schedule 80 PVC screen in the water table.

WESTEC recommends that a second monitoring well be installed downgradient of the proposed leach pad. The recommended location is shown on Figure 4.3 as MW-2. Piezometer H-3 was installed downgradient of the proposed waste dump and can also be used as a monitoring well.

5.2 PIEZOMETER WELLS

Eight piezometers were installed in and around the proposed mine project area to evaluate static groundwater elevations, to determine geologic formations, and to estimate in situ aquifer hydraulic properties. The locations of the eight piezometers are shown in Figure 4.3. Each of the piezometers was installed in a reverse circulation exploration borehole. The boreholes were drilled with a 5¾-inch-diameter hammer bit to the total depth. The holes were backfilled to the desired screen depth with cuttings. After backfilling, 1½-inch schedule 80 PVC pipe with 20 feet of perforated casing was installed at the desired depth, and 25 to 80 feet of cuttings were placed around the perforated casing. The gravel pack was capped with approximately 5 feet of coarse bentonite. Well data for the piezometers installed in the alluvial and bedrock aquifers is summarized in Table 4.2 and Table 4.3. Geologic logs for the piezometer wells are included in Appendix D.

5.3 WATER SUPPLY TEST WELL

A production test well, PW-1, was installed at the Imperial Project site to test aquifer hydrologic parameters and to evaluate the groundwater supply to meet anticipated project water requirements. Well PW-1 is in the SW 1/4, SE ½, Section 15, Township 14 South, Range 20 East San Bernardino Baseline and Meridian and is shown in Figure 4-3. The well is located approximately 4.5 miles southwest of the proposed process and mine facilities.

PW-1 was drilled using a mud rotary drilling system equipped with a tricone bit. Forty feet of 18-inch conductor casing was installed and a 17.5-inch borehole was drilled from 40 feet to a total depth of 960 feet. The well was constructed of 12-inch schedule 40 low carbon steel, with 200 feet of 0.090 mill slot well screen placed at the base of the well. The well screen extended from 918 feet below ground surface (bgs) to 718 feet bgs. A well cap was welded to the top of the casing to prevent tampering with the test well. A construction diagram for well PW-1 is shown in Figure 5-2. These well features conform with California Well Standards. A geologic and well construction log is included in Appendix D.

6.0 MINE SITE WATER SUPPLY

6.1 PUMP TEST

Production test well PW-1 was installed in the alluvial basin confined aquifer approximately 4.5 miles from the proposed Imperial mine and process facilities. The purpose of the well was to test hydrogeologic parameters and evaluate groundwater supply for the Imperial Project.

A 48-hour constant rate pumping and recovery test was performed on the production test well, described in Section 5.3, at a sustained pumping rate of 500 gallons per minute (gpm). Groundwater was derived from about 200 feet of saturated alluvial deposits at a depth of between 718 and 918 feet (screened interval) in well PW-1 during the test. Piezometer H-4, located approximately 91 feet west of the test well, was used as an observation well to measure the behavior of the hydraulic head in the aquifer during the pump test. Depth-to-water measurements in the production test well and the piezometer were taken throughout the pumping test. After conclusion of the pumping test, water level recovery measurements were made in the well and the piezometer.

Total drawdown of water level in the production test well at the end of the 48-hour pumping test was about 130 feet. Most of the drawdown during the pump test occurred during the first five minutes, after which the rate of decline of the water level was significantly less. A portion of this drawdown was attributable to well losses at the intake zone.

Field measured water-level data from the aquifer stress test was analyzed to determine aquifer hydraulic properties. Aquifer hydraulic characteristics were obtained by analysis and evaluation of both the pump test and recovery test data using two computational methods, the Theis and Jacob methods (Kruseman, 1991). The drawdown curve of water levels measured in the observation piezometer matched reasonably well with a Theis Curve for a confined aquifer showing leakage through one of the confining layers. Field measurement data and computations are included in Appendix E.

Transmissivity values of the alluvial deposits in the vicinity of the production test well were calculated to range from about 7,200 gallons per day per foot (gpd/ft) (965 ft^2/day) to 42,508

gpd/ft (5,696 ft^2/day). With a saturated thickness of 200 feet (well screen length), an average hydraulic conductivity of the alluvial aquifer was calculated to be about 116 gpd/ft^2 (16 ft/day). Water-level observations made in piezometer H-4 were used to estimate the storage coefficient of the alluvial deposits. Hydraulic storage coefficient values ranging from 0.001 to 0.02 were calculated from the pump test and recovery test data. Published storage values for confined aquifers are 0.005 or less, with storage values for unconfined aquifers ranging from 0.3 to 0.01 (Freeze and Cherry, 1979).

6.2 EVALUATION OF GROUNDWATER USAGE

The proposed Imperial Mine project would extract groundwater from water supply wells located southwest of the mine in the Amos/Ogilby alluvial basin. Potential effects of proposed water supply withdrawals on the conditions in the alluvial basin and in surrounding vicinity wells were evaluated using conventional well hydraulic numerical analyses (Kruseman, 1991). Projected drawdown of groundwater levels in the vicinity of a pumping well as a function of time was calculated. For this analysis, it was assumed that a water supply well would be constructed in the vicinity of the test production well, PW-1. This well would be capable of supplying the anticipated average water demand of 725 gallons per minute (gpm) or approximately 1,170 acre-feet per year for 20 years (the maximum anticipated life of the operation).

The hydraulic conductivity of the alluvium in the area of potential influence was assumed to be similar to that determined from the pumping and recovery test conducted in the production test well. Drawdown of groundwater levels was calculated using a saturated aquifer thickness of 300 feet, 400 feet, 500 feet, and 600 feet, respectively, as drilling indicated that the aquifer was at least 300-feet thick. An average hydraulic conductivity value of 16 ft/day, obtained from the pump and recovery test calculations, was used. A storage coefficient value of 0.02 and 0.002 was used in the groundwater level drawdown calculations.

Distributions of projected drawdown of alluvial groundwater levels after 20 years of continuous pumping are shown Table 6.1 for a saturated aquifer thickness of 300 feet, 400 feet, 500, and 600 feet respectively, and storage coefficient values of 0.02 and 0.002. Groundwater drawdowns of 1.6 to 1.8 feet are projected to occur at distances of approximately 50,000 feet from the well with a storage coefficient of 0.02. With a storage coefficient value of 0.002 projected drawdowns at 50,000 feet from the well increase to 4.0 to 6.4 feet.

TABLE 6.1
DRAWDOWN AFTER 20 YEARS

Pumping Rate (gpm)	Aquifer Thickness (ft)	Transmissivity (ft^2/day)	Storage Coefficient	Distance to Drawdown Contour in feet			
				1,000	10,000	20,000	50,000
725	300	4,800	0.02	19.2	8.6	5.4	1.8
725	400	6,400	0.02	14.9	6.9	4.5	1.7
725	500	8,000	0.02	12.2	5.8	4.0	1.6
725	600	9,600	0.02	10.4	5.1	3.4	1.5
725	300	4,800	0.002	24.4	13.8	10.6	6.4
725	400	6,400	0.002	18.8	10.8	8.5	5.3
725	500	8,000	0.002	15.4	9.0	7.1	4.6
725	600	9,600	0.002	13.0	7.7	6.1	4.0

As groundwater extraction continued for the proposed mine project life, the localized cone of depression that would form around the pumping well would potentially affect the water levels at several other wells within the vicinity. A comparison of the projected drawdown estimates in the surrounding wells and the total water column in each, based on available information, is shown in Table 6.2 and Figure 6-1. Drawdown estimates in the Gold Rock Ranch well, the Mesquite Mine GF-3A well, and the American Girl Mine 26-2 well after 20 years have been calculated. Estimated drawdowns have been calculated for an aquifer 500 feet thick, and with a storativity value of 0.02, assuming a project water demand of 725 gpm. These estimated drawdown projections assume the following: (1) wells are located within the same aquifer basin as the proposed mine project water supply well; (2) they do not account for aquifer recharge, 100,000 acre feet/year for the combined basins; and (3) the aquifer may be much thicker than assumed.

TABLE 6.2
DRAWDOWN IN GOLD ROCK RANCH, MESQUITE MINE, AND AMERICAN GIRL MINE WELLS

PUMPING RATE (gpm)	LENGTH OF TIME PUMPING (years)	TRANSMISSIVITY (sq. ft./day)	GOLD ROCK RANCH WELL (125 ft. water column) 4 miles from well Feet of Drawdown	MESQUITE MINE WELL (470 ft. water column) 9 miles from well Feet of Drawdown	AMERICAN GIRL MINE WELL (26-2) (110 ft. water column) 9 miles from well Feet of Drawdown
725	20	8,000	3.7	1.8	1.8

The Gold Rock Ranch well, located approximately 4.5 miles southwest of the proposed mine project water supply well, may have the most potential drawdown. A drawdown of 3.7 feet is projected in the Gold Rock Ranch well after 20 years of pumping. The estimated drawdown at the Gold Rock Ranch well represents 3 percent of the 125-foot depth of water in the well. At the Mesquite Mine well, the projected maximum drawdown of 1.8 feet represents about 0.5 percent of the 470-foot depth of water in that well, and the 1.8 feet of drawdown at the American Girl Mine well would represent about 1.5 percent of the 110 feet of water available at that location.

Based on the comparison of the water to be extracted at the Imperial Project in relationship to the estimated usable and recoverable stored water and estimated recharge, the project should not significantly impact the alluvial groundwater resources of the East Mesa and Amos/Ogilby Basins. CHEMGOLD's estimated extraction rate of 1,170 acre feet/year represents about 1 percent of the annual recharge of 100,000 acre feet/year estimated for the combined East Mesa and Amos/Ogilby Basins, or 2 percent of the 50,000 acre feet/year of recharge estimated for the Amos/Ogilby Basin. Over a 20-year projected project life, CHEMGOLD will use an estimated 23,400 acre feet of water. This would represent approximately 0.01 percent of the estimated 229,000,000 acre feet of useable and recoverable water in the East Mesa and Amos/Ogilby Basins.

7.0 WATER CHEMISTRY

7.1 REGIONAL WATER CHEMISTRY

The regional groundwater chemistry in the Amos/Ogilby Basin is characterized by the geographic and geologic controls that govern the occurrence, movement, and chemical quality of the groundwater. Variations in the chemical quality of the water contained in the rocks are due to differences in location with respect to the water table and recharge areas, to compositional differences in sources of recharge, and to high evaporation rates associated with the hot arid climate.

Groundwater is generally saline in the portion of the Amos/Ogilby Basin underlain by alluvial materials. The salinity has resulted from storm water infiltration leaching soluble evaporates from sedimentary rocks located above the water table (Loeltz, 1975).

An extensive hydrologic characterization of the Amos/Ogilby Basin has never been completed, but a sufficient number of water samples have been collected to permit a cursory evaluation of groundwater quality. Some generalizations can be made in regards to sampling location and depth based on the chemical analyses of the water samples. Water at higher altitudes contains fewer metals and has a lower conductivity than water at lower altitudes. Groundwater extracted from deep wells tends to be more mineralized than shallow groundwater (Loeltz, 1975; Dutcher, 1972).

Generally in areas where leakage from the canals is a significant recharge source, the chemical quality of the water resembles that of Colorado River water, which is characterized by sulfate as the predominant anion. Where leakage has not been substantial, sodium or bicarbonate is generally the principal anion. Water quality analyses for wells in the vicinity of the mine project are shown in Table 7.1. Chemical analyses of water samples extracted from the Singer Well, a shallow well completed in bedrock, indicate that the water generally contains calcium and sodium sulfates. The other wells listed in Table 7.1 are all located in alluvial materials. Analyses of water samples collected from the alluvial wells indicate the groundwater is characteristically higher in sodium chloride.

Chemical quality data for the alluvium and bedrock aquifer shows the water quality to be characterized by high values of salinity, total dissolved solids (TDS), chloride, fluoride, sulfate, and certain metals. Total dissolved solids values in the wells range from 1,100 mg/l in the Vista and

TABLE 7.1
REGIONAL WATER CHEMISTRY ANALYSIS

ELEMENT (mg/l)	Current Water Quality Standards	Glamis Well 4/25/72	Glamis Well 2/04/84	Boardman Well 2/04/84	Vista Well 1/09/62	Vista Well 6/06/62	Vista Well 12/09/63	Vista Well 8/30/82	Gold Rock 1/19/49	Gold Rock 5/20/64	Gold Rock 9/29/68	Gold Rock 12/09/71	Singer Well 10/30/74	Singer Well 2/04/84
Alkalinity (Bicarb)					85	88	94	87	104	67	84			
Arsenic	0.05(1)							0.015					0.002	0.005
Barium	1.0(1)							<0.01						
Cadmium	0.005(1)							<0.01						
Calcium		79			52	57	53	48	149	116	24	50	495	
Chloride	250(2)		1371	1333	430	414	430	445	667	897	348		6107	286
Chromium	0.05(1)		<0.01	<0.01				0.07						<0.01
Cobalt								<0.02						
Conductance (umho/cm)			5490	5560										2250
Copper	1.0(2)							0.06					0.05	
Cyanide (WAD)	0.2(1)							<0.01						
Fluoride			2.81	2.80	3.2	3.2	3.4	1.74	n/a	1.8	1.9*		1.0	1.6
Iron	0.3(2)		1.1	0.37				5.0					7.0	0.82
Lead								<0.01					0.09	
Magnesium					2.6	5.1	3.4	4.4	21	12	5.8		162	
Manganese	0.05(2)		0.12	0.05				0.06					1.0	0.06
Mercury	0.002(1)							<0.001						
Nickel	0.1(1)							<0.01						
Nitrate Nitrogen	10(1)				3.1		3.4	1.8					26	
pH (pH units)		6.8	7.73	7.75	7.7	7.6	7.6	6.89	n/a	7.7	7.5		7.20	7.85
Potassium		86			n/a	n/a	6.1	6.2				4.3		
Scandium														
Selenium	0.05(1)							<0.001						
Silver	0.1(2)		0.067	0.032				<0.01						0.005
Sodium		1135			n/a	n/a	368	372	n/a	590	n/a	312	3775	
Sulfate	250(2)		168	155	248	250	244	261	242	275	125		2531	415
TDS	500(2)		3046	3080	1170	1140	1185	1145	1510	1950	844		13334	1328
Turbidity								30						
Zinc	5.0(2)							0.64					1.0	

0.05(1)
0.05(2)

Current California Primary Maximum Contaminant Levels
Current California Secondary Maximum Contaminant Levels

TABLE 7.1
REGIONAL WATER CHEMISTRY ANALYSIS

ELEMENT (mg/l)	Current Water Quality Standards	GF - 1 Well 8/30/82	GF - 1 Well 3/21/83	GF - 1 Well 12/05/83	GF - 1 Well 5/02/84	GF - 1 Well 10/25/85	GF - 1 Well 12/12/85	GF - 1 Well 05/21/86	GF - 2 Well 4/19/85	GF - 2 Well 4/21/85	GF - 2 Well 10/25/85	GF - 2 Well 5/21/86	GF - 3A Well 4/21/86	GF - 3A Well 7/16/91
Alkalinity (Bicarb)														
Arsenic	0.05(1)	0.015	0.004	0.005	0.006	0.001	0.014	n/a	0.004	0.004	<0.001	n/a	0.006	<0.001
Barium	1.0(1)													
Cadmium	0.005(1)													
Calcium														
Chloride	250(2)	445	443	399	441	425	436	n/a	403	404	404	n/a	386	410
Chromium	0.05(1)	0.07	<0.01	0.02	<0.01	0.02	<0.01	n/a	0.01	0.01	<0.01	n/a	<0.01	0.01
Cobalt														
Conductance (umho/cm)		1940	2150	1900	2150	1779	1954	1950	1980	1980	1699	1886	1643	1092
Copper	1.0(2)													
Cyanide (WAD)	0.2(1)													
Fluoride		1.74	4.80	4.30	2.50	3.50	2.30	n/a	1.9	2.1	1.6	n/a	1.82	2.5
Iron	0.3(2)	5.00	0.36	0.13	0.01	0.82	0.53	n/a	0.08	0.09	0.09	n/a	0.10	0.17
Lead														
Magnesium														
Manganese	0.05(2)	0.06	0.01	<0.01	0.01	0.01	<0.01	n/a	0.01	<0.01	0.09	n/a	<0.01	3.3
Mercury	0.002(1)													
Nickel	0.1(1)													
Nitrate Nitrogen	10(1)													
pH (pH units)		6.89	7.06	7.28	6.90	7.81	7.81	7.80	8.13	8.01	7.68	7.60	7.94	8.00
Potassium														
Scandium														
Selenium	0.05(1)													
Silver	0.1(2)													
Sodium														
Sulfate	250(2)	261	239	252	274	265	266	n/a	240	237	252	n/a	237	250
TDS	500(2)	1145	1084	1216	1178	1162	1137	1309	1072	1108	1088	1217	1069	2100
Turbidity														
Zinc	5.0(2)													

0.05(1)
0.05(2)

Current California Primary Maximum Contaminant Levels
Current California Secondary Maximum Contaminant Levels

Goldfield wells to greater than 3,000 mg/l in the Glamis and Boardman wells. Suitability of the groundwater as drinking water is poor to marginal. Treatment of the groundwater is generally required prior to potable use. However, despite exceeding drinking water standards, the water quality is suitable for non-potable use such as mining and milling operations.

7.2 SITE WATER CHEMISTRY

Water quality characteristics of groundwater samples collected from the mine site piezometers, the monitoring well, and the test well are shown in Table 7.2. Samples were collected by CHEMGOLD. Sample PW-1 was taken at the end of the 48-hour constant rate pump test conducted in the test well and is probably most representative of the alluvial aquifer quality.

Iron, aluminum and manganese concentrations exceeded California Domestic Secondary Water Quality and Monitoring Standards in a number of the wells sampled. These metal concentrations may be due to the use of drilling fluids during the drilling of the wells. The fluoride concentration in sample PW-1 collected after the 48-hour pumping test was 1.6 mg/l, slightly exceeding the California maximum contaminant concentration of 1.4 mg/l. Other trace element concentrations were below applicable water quality standards.

Stiff and Piper diagrams of groundwater samples collected from the mine site are shown in Figure 7.1 . Included in the diagrams are water quality data for samples collected from the piezometers, the monitoring well, and the production test well. For comparison, the water quality analyses from the Vista well have been included in the diagrams. The Vista well was the only regional well that had a complete suite of analyses required for inclusion in the Stiff and Piper plots. The data indicates that groundwater collected from piezometers EC-5 and H-1 and the production test well, PW-1, was sodium chloride in character. Groundwater samples collected from the other wells had sulfate and carbonate as the major anions, with sodium being the predominant cation. Total dissolved solids levels in the samples ranged from 600 to 1,500 mg/l. Laboratory analytical results are included in Appendix F.

Chemical analyses show increased levels of aluminum, manganese, and iron in the piezometers and monitoring wells. These metal concentrations may be due to the drilling fluids used during the installation of these wells. Despite exceeding some of the secondary drinking water standards, the water quality is suitable for non-potable use such as mining and milling operations.

TABLE 7.2
SITE WATER CHEMISTRY ANALYSIS

ELEMENT (mg/l)	Units	Current Water Quality Standards	EC - 5 8/30/95	WC - 5 8/30/95	MW # 1 8/30/95	WR - 2 8/30/95	94H - 1 Well 11/28/94
Alkalinity (BiCarb)	mg/l		56B	141B	138B	151B	116B
Aluminum	mg/l	0.2(2)	2.4	0.3	0.5	0.4	
Antimony	mg/l	0.006(1)	<0.5	<0.5	<0.5	<0.5	
Arsenic	mg/l	0.05(1)	<0.005	<0.005	<0.005	0.006	
Barium	mg/l	1.0(1)	<0.1	0.1	0.2	<0.1	
Beryllium	mg/l	0.004(1)	<0.1	<0.1	<0.1	<0.1	
Bismuth	mg/l		<0.1	<0.1	<0.1	<0.1	
Cadmium	mg/l	0.005(1)	<0.0004	<0.0002	0.0004	0.0016	
Calcium	mg/l		84	85	83	30	24
Chloride	mg/l	250 (2)	480	88	92	82	210
Chromium	mg/l	0.05(1)	<0.1	<0.1	<0.1	<0.1	
Cobalt	mg/l		<0.1	<0.1	<0.1	<0.1	
Conductance	umhos/cm						
Copper	mg/l	1.0(2)	<0.1	<0.1	<0.1	<0.1	
Cyanide (WAD)	mg/l	0.2(1)	<0.005	<0.005	<0.005	<0.005	
Fluoride	mg/l		0.1	0.2	0.2	0.7	0.62
Gallium	mg/l		<0.1	<0.1	<0.1	<0.1	
Iron	mg/l	0.3(2)	7	0.8	1.4	1.7	
Lanthanum	mg/l		<0.1	<0.1	<0.1	<0.1	
Lead	mg/l			0.002	0.009	0.014	
Lithium	mg/l		<0.1	<0.1	<0.1	<0.1	
Magnesium	mg/l		4.1	34	31	4.8	2.7
Manganese	mg/l	0.05 (2)	0.4	<0.1	<0.1	0.1	
Mercury	mg/l	0.002(1)	<0.0005	<0.0005	<0.0005	<0.0005	
Molybdenum	mg/l		<0.5	<0.5	<0.5	<0.5	
Nickel	mg/l	0.1(1)	<0.1	<0.1	<0.1	<0.1	
Nitrate Nitrogen	mg/l	10(1)	1.2	2.2	0.1	<0.1	<0.1N
pH	ph units	6.8 - 8.5	7.44	7.72	7.99	7.67	7.20
Phosphorous	mg/l		<0.1	<0.1	<0.1	<0.1	
Potassium	mg/l		4.9	5.4	6	8.5	7.4
Scandium	mg/l		<0.1	<0.1	<0.1	<0.1	
Selenium	mg/l	0.05(1)	<0.001	<0.001	<0.001	<0.001	
Silver	mg/l	0.1(2)	<0.0005	<0.0005	<0.0005	<0.0005	
Sodium	mg/l		400	140	130	170	210
Strontium	mg/l		2.9	1.6	1.8	1	
Sulfate	mg/l	250 (2)	340	300	290	140	120
TDS	mg/l	500 (2)	1454	856	799	590	666
Thallium	mg/l	0.002(1)	<1	<1	<1	<1	
Tin	mg/l		<1	<1	<1	<1	
Titanium	mg/l		<1	<0.1	<0.1	<0.1	
Vanadium	mg/l		<0.1	<0.1	<0.1	<0.1	
Zinc	mg/l	5.0(2)	0.6	0.3	0.3	2.8	

0.05(1)
0.05(2)

Current California Primary Maximum Contaminant Levels
Current California Secondary Maximum Contaminant Levels

TABLE 7.2
SITE WATER CHEMISTRY ANALYSIS

ELEMENT (mg/l)	Units	Current Water Quality Standards	WR - 2 11/28/95	WC - 5 11/28/95	MW #1 Well 11/28/95	PW-1 Well 11/19/95
Alkalinity (BiCarb)	mg/l		183B	172B	183B	32B
Aluminum	mg/l	0.2(2)	1.3	1.5	1.7	<0.1
Antimony	mg/l	0.006(1)	<0.5	<0.5	<0.5	<0.002
Arsenic	mg/l	0.05(1)	<0.005	<0.005	0.005	0.009
Barium	mg/l	1.0(1)	<0.1	<0.1	<0.1	<0.1
Beryllium	mg/l	0.004(1)	<0.1	<0.1	<0.1	<0.0002
Bismuth	mg/l		<0.1	<0.1	<0.1	<0.1
Cadmium	mg/l	0.005(1)	0.0002	<0.0002	0.0006	<0.0002
Calcium	mg/l		29	30	38	57
Chloride	mg/l	250 (2)	110	110	110	320
Chromium	mg/l	0.05(1)	<0.1	<0.1	<0.1	<0.1
Cobalt	mg/l		<0.1	<0.1	<0.1	<0.1
Conductance	umhos/cm		n/a	n/a	n/a	n/a
Copper	mg/l	1.0(2)	<0.1	<0.1	<0.1	<0.1
Cyanide (WAD)	mg/l	0.2(1)	<0.005	<0.005	<0.005	<0.005
Fluoride	mg/l		0.6	0.5	0.5	1.6
Gallium	mg/l		<0.1	<0.1	<0.1	<0.1
Iron	mg/l	0.3 (2)	2.7	1.8	3.4	0.4
Lanthanum	mg/l		<0.1	<0.1	<0.1	<0.1
Lead	mg/l		0.009	<0.01	0.015	<0.002
Lithium	mg/l		<0.1	<0.1	<0.1	0.1
Magnesium	mg/l		4	4.8	6	1.5
Manganese	mg/l	0.05 (2)	0.3	<0.1	0.3	<0.1
Mercury	mg/l	0.002(1)	<0.0005	<0.0005	<0.0005	<0.0005
Molybdenum	mg/l		<0.5	<0.5	<0.5	<0.5
Nickel	mg/l	0.1(1)	<0.1	<0.1	<0.1	<0.1
Nitrate Nitrogen	mg/l	10(1)	0.8	1.1	0.6	1.9
pH	ph units	6.8 - 8.5	7.83	7.86	7.6	8.2
Phosphorous	mg/l		0.1	<0.1	0.3	<0.1
Potassium	mg/l		5.7	5.7	6.9	0.1
Scandium	mg/l		<0.1	<0.1	<0.1	<0.1
Selenium	mg/l	0.05(1)	<0.001	<0.001	<0.001	<0.001
Silver	mg/l	0.1(2)	<0.0005	<0.0005	<0.0005	<0.0005
Sodium	mg/l		210	210	200	260
Strontium	mg/l		1.2	0.8	1.2	0.8
Sulfate	mg/l	250 (2)	190	200	200	180
TDS	mg/l	500 (2)	678	690	712	906
Thallium	mg/l	0.002(1)	<1	<1	<1	0.001
Tin	mg/l		<1	<1	<1	<1
Titanium	mg/l		<0.1	<0.1	<0.1	<0.1
Vanadium	mg/l		<0.1	<0.1	<0.1	<0.1
Zinc	mg/l	5.0(2)	0.3	0.2	0.9	<0.1

0.05
0.05

Current California Primary Maximum Contaminant Levels
Current California Secondary Maximum Contaminant Levels

8.0 SUMMARY

This report characterizes the hydrogeology of the Imperial Project area. This area includes the mine site and processing facilities located southwest of Indian Pass and the alluvial basin area located southwest of the Chocolate Mountains and northwest of the Cargo Muchacho Mountains. The primary purpose of the study was to characterize and assess the existing hydrogeologic conditions of the mine project area.

The Imperial Project is located within the Salton Sea Drainage Basin, a closed hydrologic basin in which all surface flows drain toward the Salton Sea, a saline water body which has no outlet. Surface flows either evaporate or infiltrate into the wash bottoms or outwash areas east of the Algodones Sand Dunes. There are no free-standing surface waters within the Imperial Project area or in the immediate vicinity.

Precipitation in the project area is limited. Annual rainfall ranges from less than 5 inches per year on the valley floor and alluvial slopes, to 5.5 inches in the mountains. Evaporation rates in the project area are estimated to be about 100 inches per year. The region's low precipitation rate, coupled with the high evaporation rate and the presence of highly permeable soils in the washes, precludes the formation of perennial or intermittent steams and results in limited recharge of the groundwater reservoir by infiltration of waters of meteoric origin. Surface water drainages within the Imperial Project consist of a series of subparallel ephemeral washes which are fed by precipitation from infrequent winter storms and summer thunderstorms. No springs, seeps or surface water have been identified in the project site area.

The Colorado River, located approximately 7 miles northeast of the project at its closest point, represents the closest perennial water source. However, the Colorado River is located on the other side of the Chocolate Mountains and does not flow into the Salton Sea Drainage Basin. The All-American Canal, located approximately 16 miles to the south, transports water from the Colorado River and is the primary source of water within the Salton Sea Drainage Basin. The Coachella Canal, which is a branch of the All-American Canal, is located approximately 19 miles southwest of the project on the other side of the Algodones Sand Dunes.

The USGS (Dutcher, 1975) has estimated that the storage capacity of usable and recoverable water in the Amos/Ogilby Basin is approximately 126,000,000 acre-feet, and the capacity of East Mesa subunit is approximately 103,000,000 acre-feet. Estimated annual recharge to the East Mesa, and Amos/Ogilby areas due to all sources is 100,000 acre feet (Environmental Solutions, Inc., 1993).

Groundwater occurs within three aquifers underlying the project area; a confined alluvial aquifer, an unconfined alluvial aquifer, and a bedrock aquifer. The alluvial aquifers consist of consolidated and unconsolidated sands and gravels, while the bedrock aquifer is comprised of metamorphic rocks. The alluvial aquifer consists of consolidated and unconsolidated sands and gravels, while the bedrock aquifer consists of metamorphic rocks. Groundwater flow within the project area is primarily from the higher elevations of the Chocolate Mountains toward the alluvial basin of the valley floor. The general groundwater gradient is northeast to southwest. Water table contours parallel the range front. Groundwater movement in the alluvial deposits within the project area occurs in a south-southwest direction.

The alluvial and bedrock aquifers were characterized during the site hydrogeological investigation. A combination of piezometer and monitoring wells were installed to determine static groundwater elevations, to evaluate the water chemistry, and to estimate in situ aquifer hydraulic properties, associated with each aquifer system. A production test well was installed to define aquifer hydrologic parameters and to evaluate the potential of groundwater to meet anticipated project water requirements. The slug test results for H-4 in the confined aquifer indicated a hydraulic conductivity of 2.8×10^{-2} cm/sec. Aquifer tests indicated that the bedrock formation has a very low hydraulic conductivity, on the order of 10^{-6} to 10^{-7} cm/sec (10^{-8} to 10^{-9} ft/sec).

Transmissivity values of the alluvial deposits in the vicinity of the production test well were calculated to range from about 7,200 gallons per day per foot (gpd/ft) (965 square feet per day (ft^2/day) to 42,508 gpd/ft (5,696 ft^2/day). With a saturated thickness of 200 feet (well screen length), an average hydraulic conductivity of the alluvial aquifer was calculated to be about 116 gpd/ft^2 (16 ft/day). Water-level observations made in piezometer H-4 were used to estimate the storage coefficient of the alluvial deposits. Hydraulic storage coefficient values ranging from 0.001 to 0.02 were calculated from the pump test and recovery test data.

The proposed Imperial Mine project would extract groundwater from water supply wells located southwest of the mine in the Amos/Ogilby alluvial basin. Potential effects of proposed water supply withdrawals on the conditions in the alluvial basin and in surrounding vicinity wells was evaluated using conventional well hydraulic numerical analyses. Projected drawdown of groundwater levels in the vicinity of a pumping well as a function of time were calculated.

Distributions of projected drawdown of alluvial groundwater levels after 20 years of continuous pumping were calculated for a saturated aquifer thickness of 300 feet, 400 feet, and 500 feet respectively, and a storage coefficient value of 0.02. Groundwater drawdowns of 1.6 to 1.8 feet are projected to occur at distances of approximately 50,000 feet from the well. The Gold Rock Ranch well, located approximately 4.5 miles southwest of the proposed mine project water supply well, may have the most potential drawdown of the regional wells. A drawdown of 3.7 feet is projected in the Gold Rock Ranch well after 20 years of pumping. The estimated drawdown at the Gold Rock Ranch well represents 3 percent of the 125-foot depth of water in the well. At the Mesquite Mine well, the projected maximum drawdown of 1.8 feet represents about 0.5 percent of the 470-foot depth of water in that well, and the 1.8 feet of drawdown at the American Girl Mine well would represent about 1.5 percent of the 110 feet of water available at that location.

The volume of groundwater contained in the alluvial sediments was estimated to determine the impact of continuous groundwater withdrawal from the aquifer during the operation of the Imperial Mine project. The conservative calculations indicated that a substantial amount of groundwater is contained in pore storage within the alluvial deposits, and the projected water requirements for the project should not cause a significant drawdown of groundwater levels in the Amos/Ogilby Basin.

The regional groundwater chemistry in the Amos/Ogilby Basin is characterized by the geographic and geologic controls that govern the occurrence, movement, and chemical quality of the groundwater. Variations in the chemical quality of the water contained in the rocks are due to differences in location with respect to the water table and recharge areas, to compositional differences in sources of recharge, and to high evaporation rates associated

with the hot arid climate. In general, water at higher altitudes appears to be less mineralized than water at lower altitudes. Groundwater extracted from deep wells tends to be more mineralized than shallow groundwater. Chemical quality data for the alluvium and bedrock aquifers in the region shows the water quality to be characterized by high values of salinity, TDS, chloride, fluoride, sulfate, and certain metals. Despite exceeding the drinking water standards, the water quality is suitable for non-potable use such as mining and milling operations.

Water quality characteristics of groundwater samples collected from the Imperial Project mine site piezometers show iron and aluminum concentrations exceeded California Domestic Secondary Water Quality and Monitoring standards. Other trace elements and fluoride concentrations were below applicable water quality standards.

9.0 RECOMMENDATIONS

Based on data and results from the hydrogeologic baseline study, WESTEC has the following recommendations:

- Consider installation of an additional monitoring well downgradient of the leach pad to establish baseline water quality conditions

- Install a second water production well within 1,000 feet of site PW-1. At this distance, there should not be undue interferences between the two wells. WESTEC recommends that construction and installation of the second production well be similar to well PW-1

- The maximum pumping rate for production well PW-1 should not exceed 550 gpm

10.0 REFERENCES

California Department of Water Resources, 1975, California's Groundwater

Dutcher, L.C., W.F. Hardt, and W.R. Moyle, Jr, 1972, *Preliminary Appraisal of Groundwater in Storage, with Reference to Geothermal Resources in the Imperial Valley Area, California*. U.S. Geologic Survey, Circular 649

Environmental Management Associates, *1996 Draft Environmental Impact Statement/ Environmental Impact Report*

Environmental Solutions, Inc., *1993 Hydrogeologic Assessment Report Mesquite Regional Landfill*

Fox, Robert C. *1984 Groundwater Resources Appraisal, Amos Basin, Imperial County, California;* Technical Report

Freeze, R.A. and J.A. Cherry, 1979, Groundwater, Prentice Hall

Hanna, T.M., E.A. Azrag, and L.C. Atkinson, 1994, *Use of an Analytical Solution for Preliminary Estimates of Groundwater Inflow to A Pit,* Mining Engineering, Vol. 46 No. 2, pp 149-152

Kruseman, G.P. and N.A. de Ridder, 1991, *Analysis and Evaluation of Pumping Test Data, Second Edition,* International Institute for Land Reclamation and Improvement

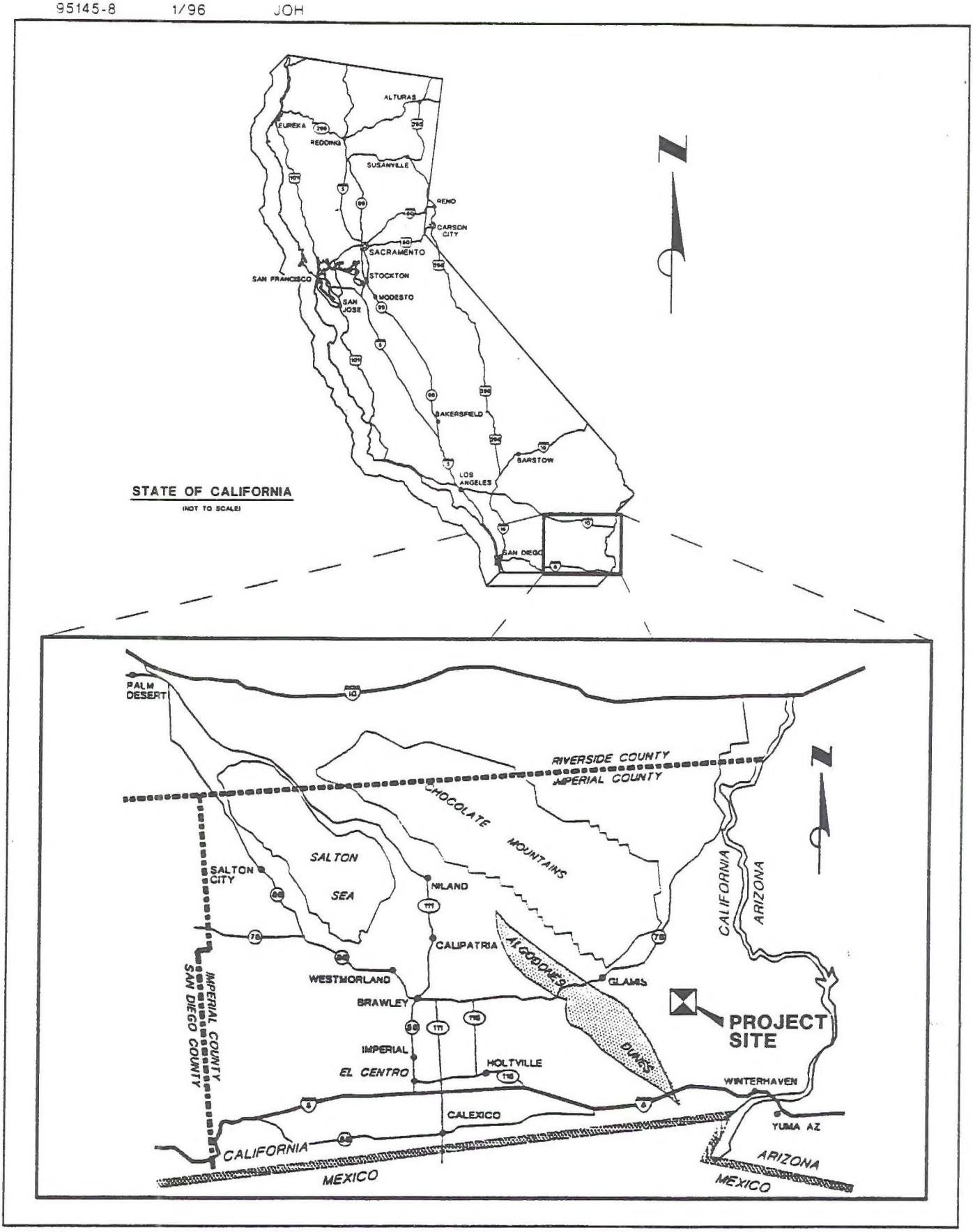
Liebler, G.S. 1988, *Geology and Gold Mineralization at the Picacho Mine, Imperial County, California*, in Schafer, R.W., et al. eds. Bulk Minable Precious Metal Deposits of the Western United States; Symposium Proceedings Geological Society of Nevada

Loeltz, O.J., B. Irelan, J.H. Robison, and F.H. Olmsted, 1975 *Geohydrologic Reconnaissance of the Imperial Valley, California*. U.S. Geological Survey, Professional Paper 486-K

Willis, A.F., 1988, *Geology and Mineralization of the Mesquite Open Pit Gold Mine*, in Schafer, R.W. et al., Bulk Minable Precious Metal Deposits of the Western United States; Symposium Proceedings: U. S. Geological Society of Nevada

Wilson, Richard P. and Sandrant, Owen-Joyce, 1994. *Method to Identify Wells that Yield Water That Will Be Replaced by Colorado River Water in Arizona, California, Nevada, and Utah*, U.S. Geological Survey, Water-Resources Investigations Report 94-4005

FIGURES



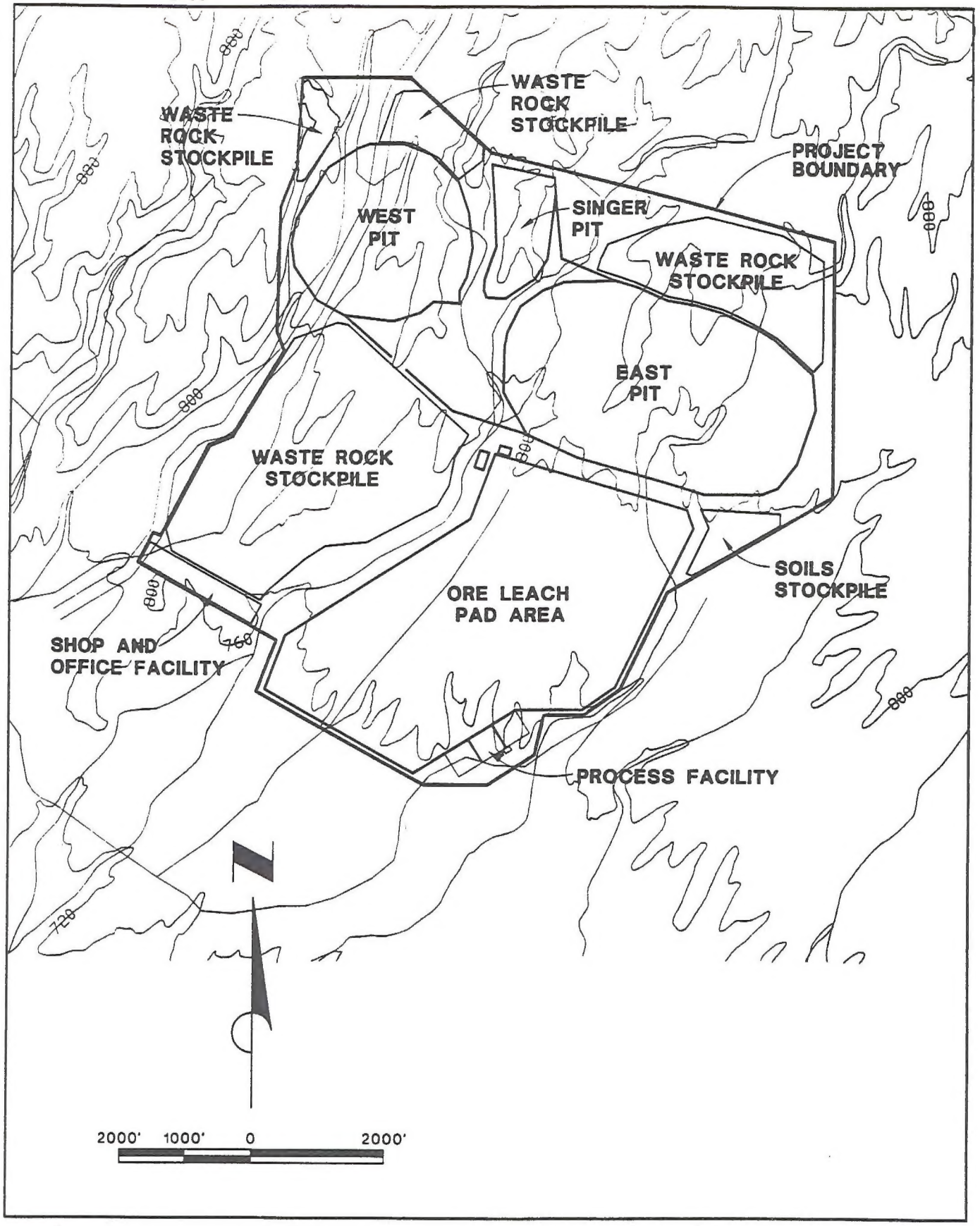
WESTEC®

FIGURE 1-1

LOCATION MAP

CHEMGOLD, INC.
IMPERIAL PROJECT
HYDROLOGY BASELINE REPORT

95145-8 2/96 JOH



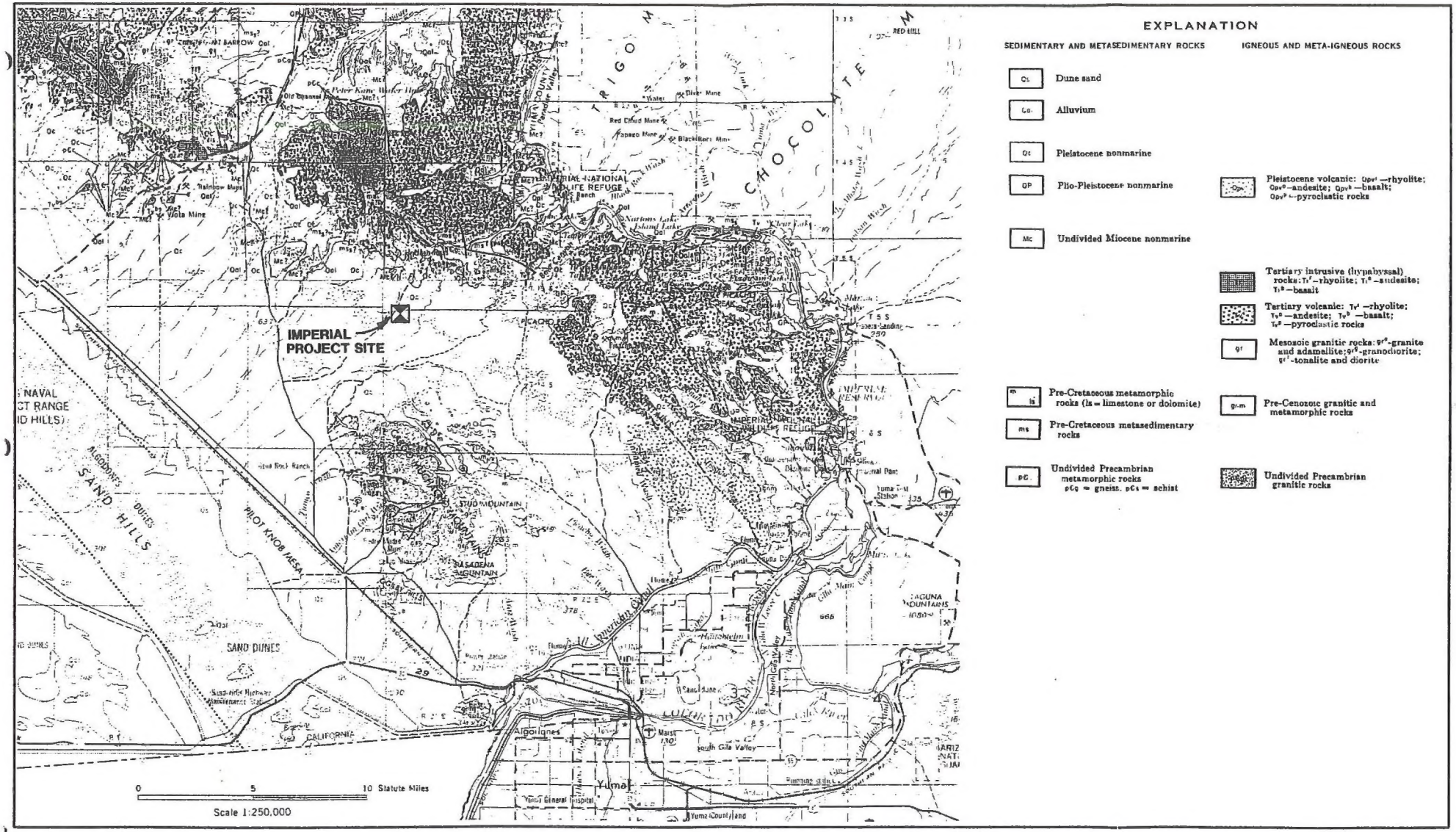
WESTEC®

FIGURE 1-2

CHEMGOLD, INC.
IMPERIAL PROJECT
HYDROLOGY BASELINE REPORT

SITE FACILITIES LAYOUT

95145-8 12/95



EXPLANATION

SEDIMENTARY AND METASEDIMENTARY ROCKS

- Qs — Dune sand
- Qa — Alluvium
- Qt — Pleistocene nonmarine
- QP — Plio-Pleistocene nonmarine
- Mc — Undivided Miocene nonmarine
- m ls — Pre-Cretaceous metamorphic rocks (ls = limestone or dolomite)
- ms — Pre-Cretaceous metasedimentary rocks
- pC — Undivided Precambrian metamorphic rocks pCg = gneiss, pCs = schist

IGNEOUS AND META-IGNEOUS ROCKS

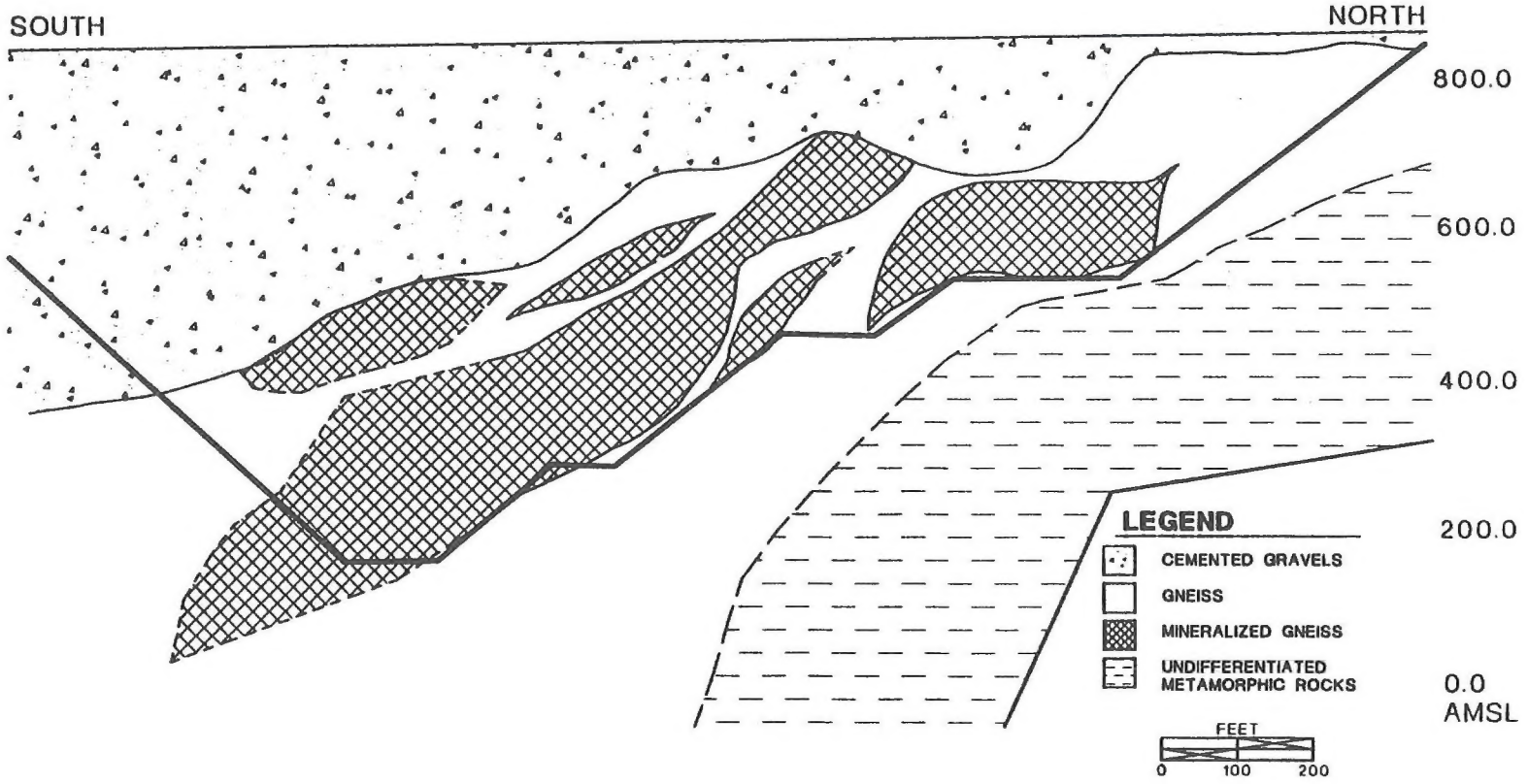
- Qpv — Pleistocene volcanic: Qpv^r—rhyolite; Qpv^a—andesite; Qpv^b—basalt; Qpv^p—pyroclastic rocks
- T_i — Tertiary intrusive (hypabyssal) rocks: T_i^r—rhyolite; T_i^a—andesite; T_i^b—basalt
- Tv — Tertiary volcanic: Tv^r—rhyolite; Tv^a—andesite; Tv^b—basalt; Tv^p—pyroclastic rocks
- gr — Mesozoic granitic rocks: gr^g-granite and adamellite; gr^d-granodiorite; gr^t-tonalite and diorite
- gr.m — Pre-Cenozoic granitic and metamorphic rocks
- pG — Undivided Precambrian granitic rocks

WESTEC

CHEMGOLD, INC.
IMPERIAL PROJECT
HYDROLOGY BASELINE REPORT

FIGURE 2-1
REGIONAL GEOLOGY

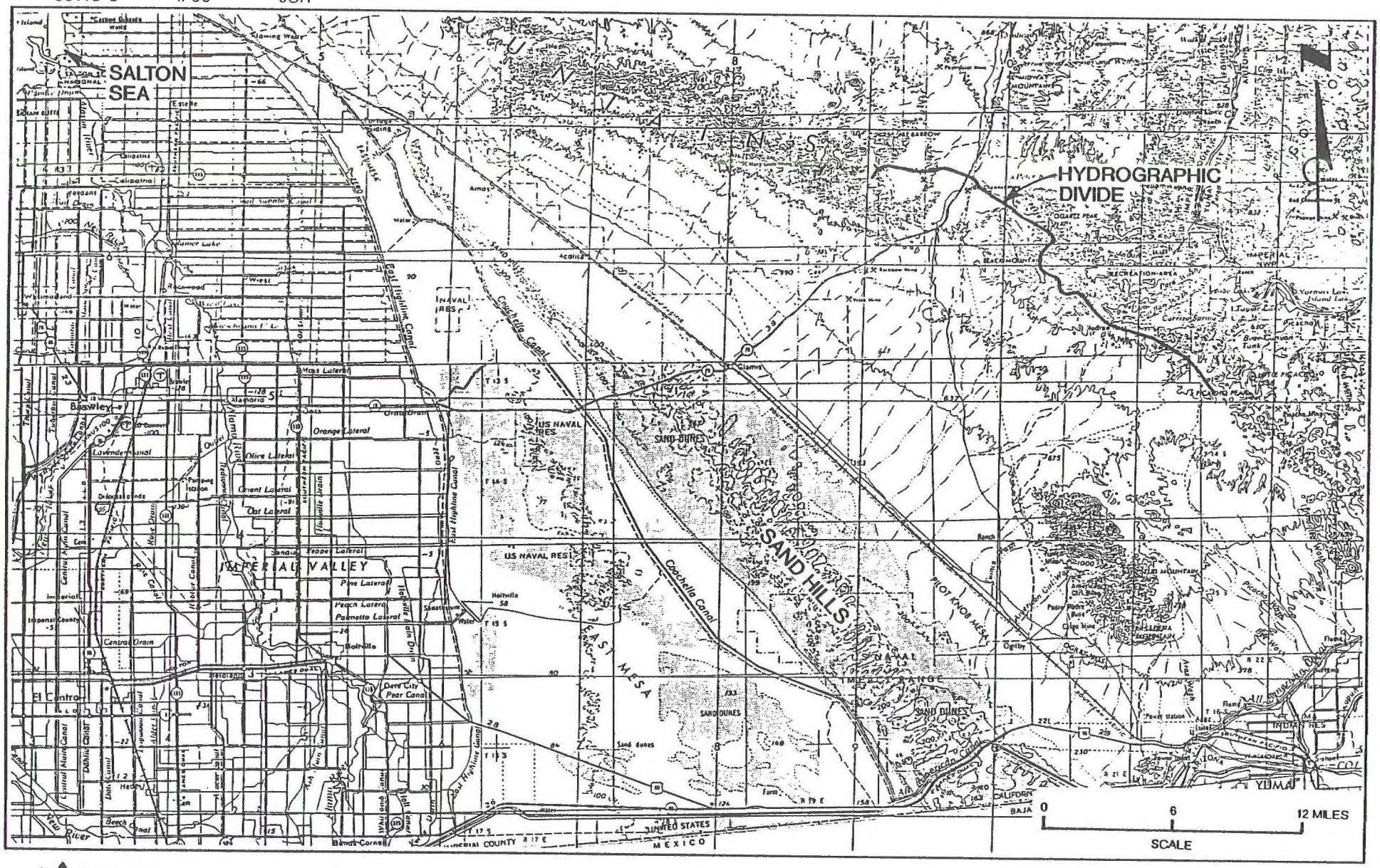
IMPERIAL PROJECT
TYPICAL CROSS SECTION
(LOOKING WEST)



WESTEC®

FIGURE 2-2

SITE GEOLOGY - CROSS SECTION

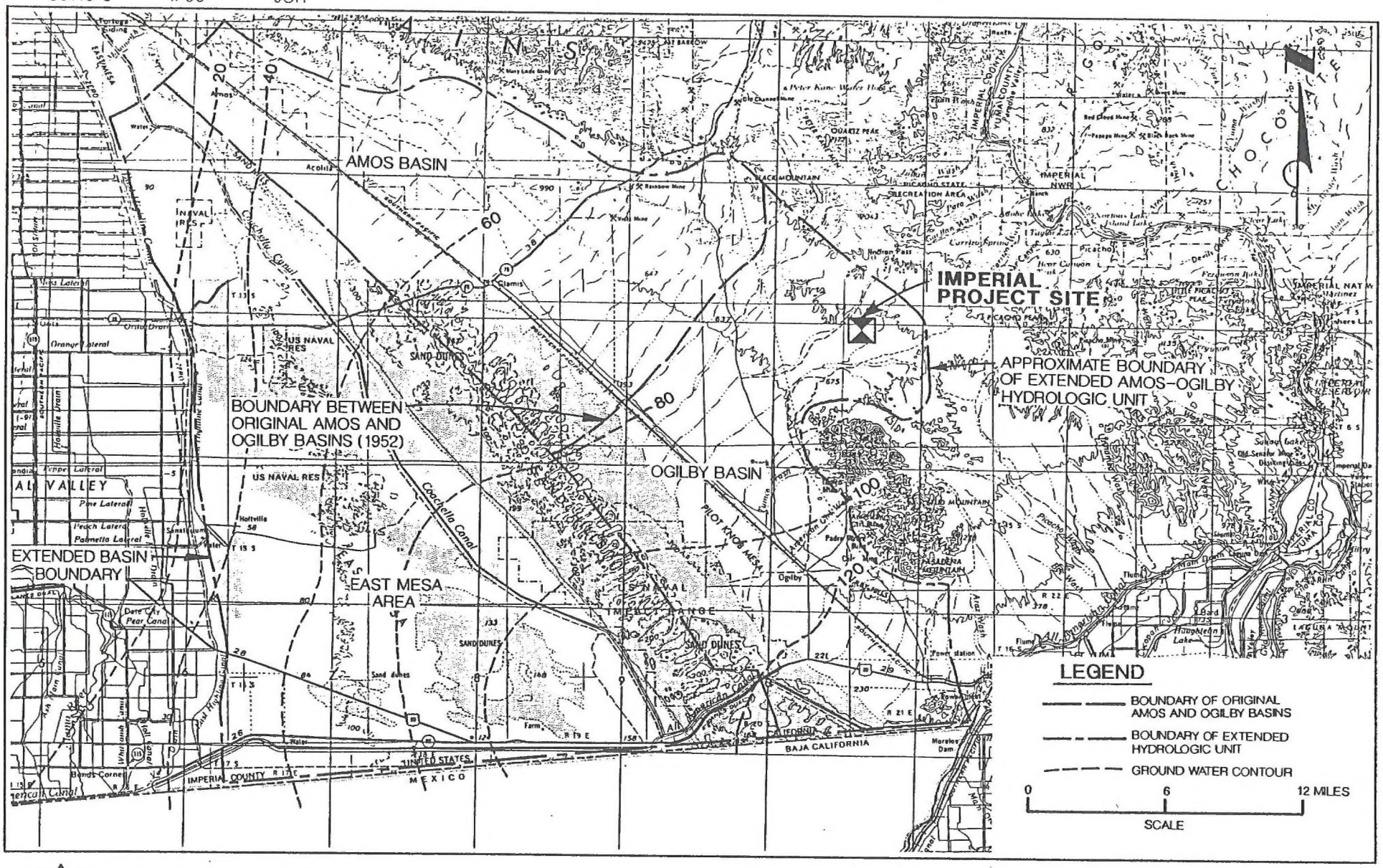


WESTEC®

FIGURE 3-1

REGIONAL HYDROGRAPHIC BASIN

CHEMGOLD, INC.
IMPERIAL PROJECT
HYDROLOGY BASELINE REPORT

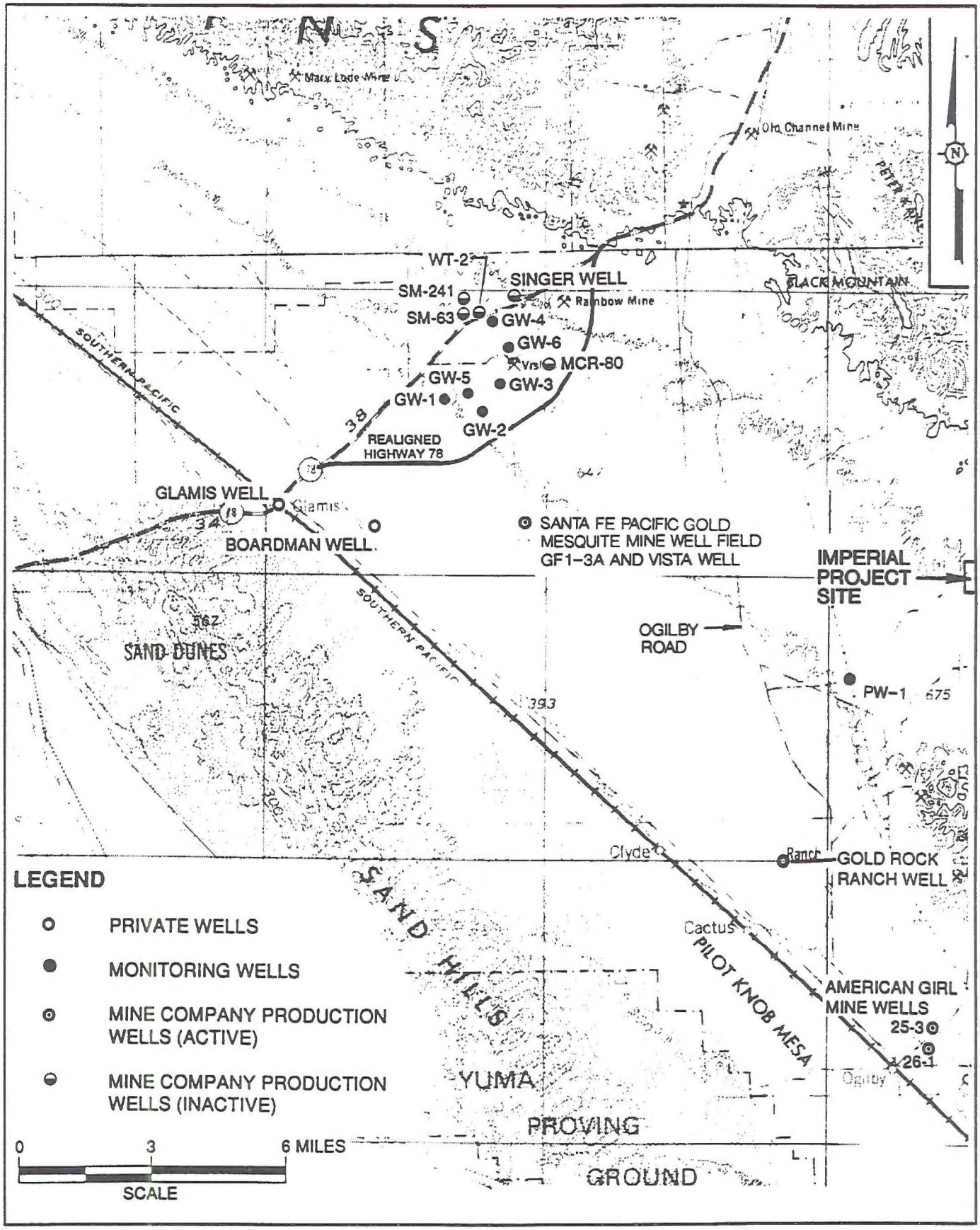


WESTEC®

FIGURE 4-1

REGIONAL HYDROGEOLOGIC BASINS

CHEMGOLD, INC.
IMPERIAL PROJECT
HYDROLOGY BASELINE REPORT

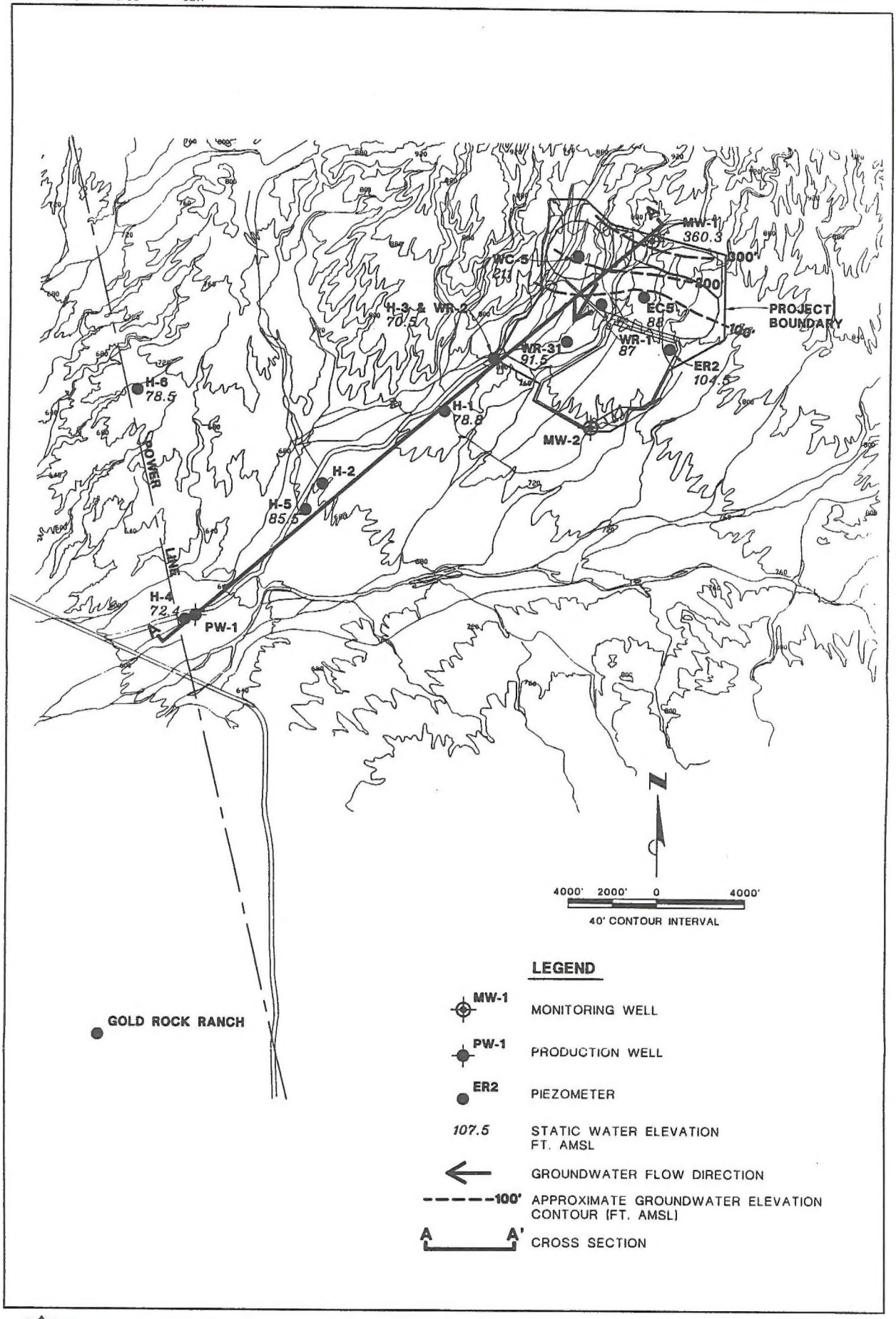


WESTEC®

FIGURE 4-2

REGIONAL WELL LOCATIONS

CHEMGOLD, INC.
IMPERIAL PROJECT
HYDROLOGY BASELINE REPORT

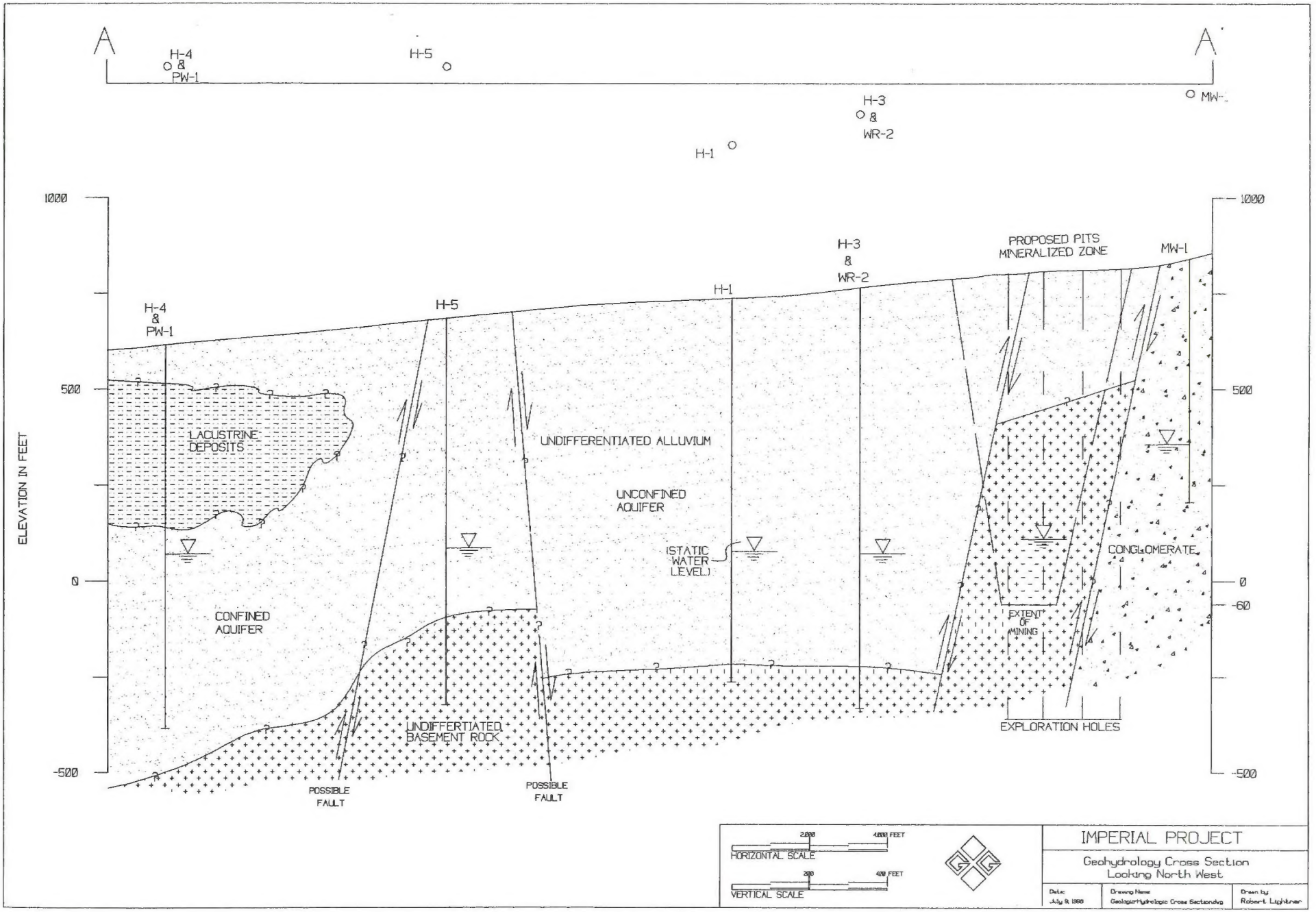


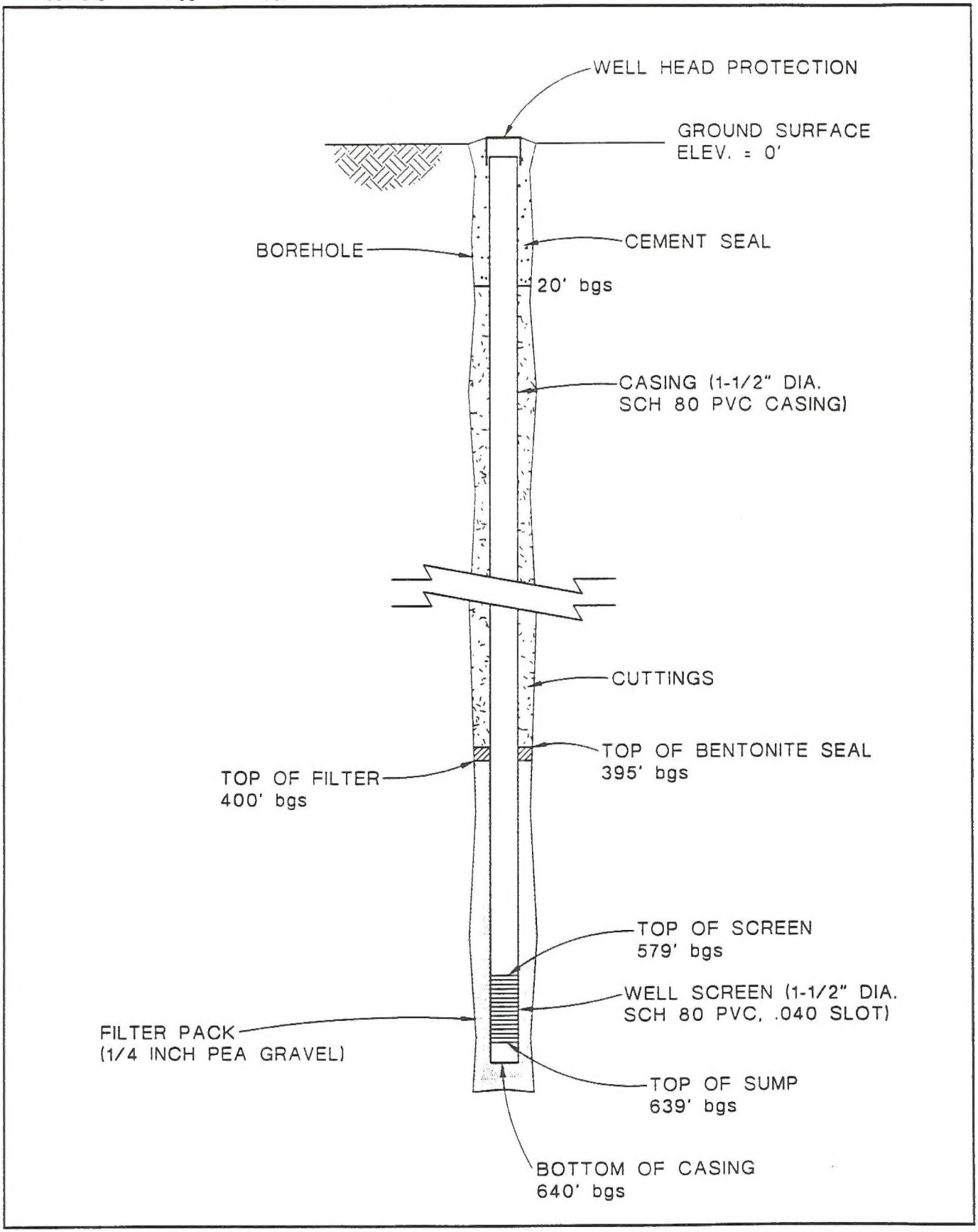
WESTEC

CHEMGOLD, INC.
IMPERIAL PROJECT
HYDROLOGY BASELINE REPORT

FIGURE 4-3

SITE PIEZOMETERS, MONITORING WELLS, PRODUCTION WELLS AND GOLD ROCK RANCH LOCATION MAP


A
A'
H-4
&
PW-1
H-5
H-1
H-3
&
WR-2
MW-1
1000
500
0
-500
ELEVATION IN FEET
PROPOSED PITS
MINERALIZED ZONE
LACUSTRINE
DEPOSITS
UNDIFFERENTIATED ALLUVIUM
UNCONFINED
AQUIFER
(STATIC
WATER
LEVEL)
CONGLOMERATE
CONFINED
AQUIFER
EXTENT
OF
MINING
UNDIFFERTIATED
BASEMENT ROCK
EXPLORATION HOLES
POSSIBLE
FAULT
POSSIBLE
FAULT
1000
500
0
-60
-500
2000
4000 FEET
HORIZONTAL SCALE
200
400 FEET
VERTICAL SCALE
IMPERIAL PROJECT
Geohydrology Cross Section
Looking North West
Date:
July 9, 1988
Drawing Name:
GeologicHydrologic Cross Sectionvg
Drawn by:
Robert Lightner

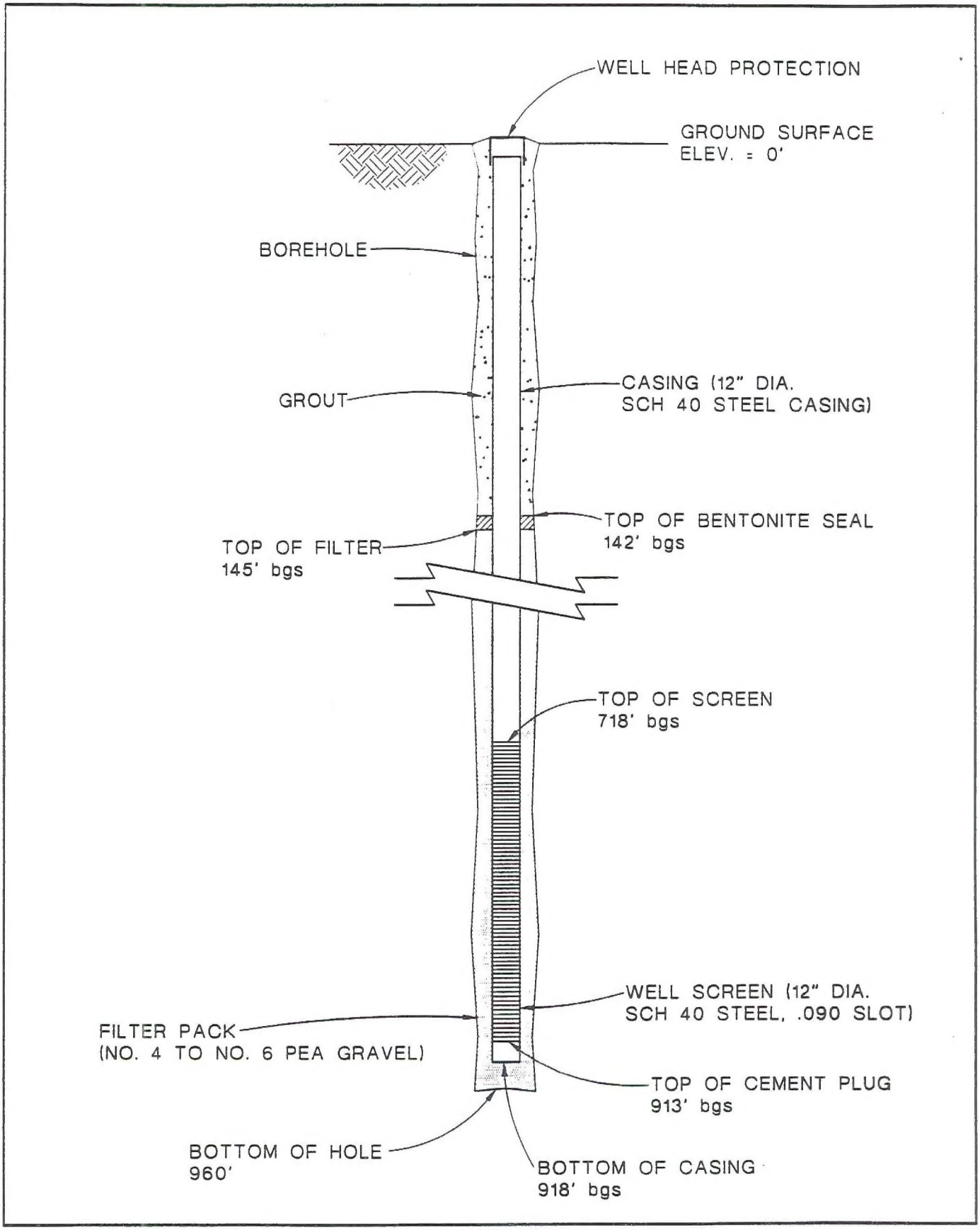


WESTEC®

FIGURE 5-1

MONITORING WELL DESIGN

CHEMGOLD, INC.
IMPERIAL PROJECT
HYDROLOGY BASELINE REPORT

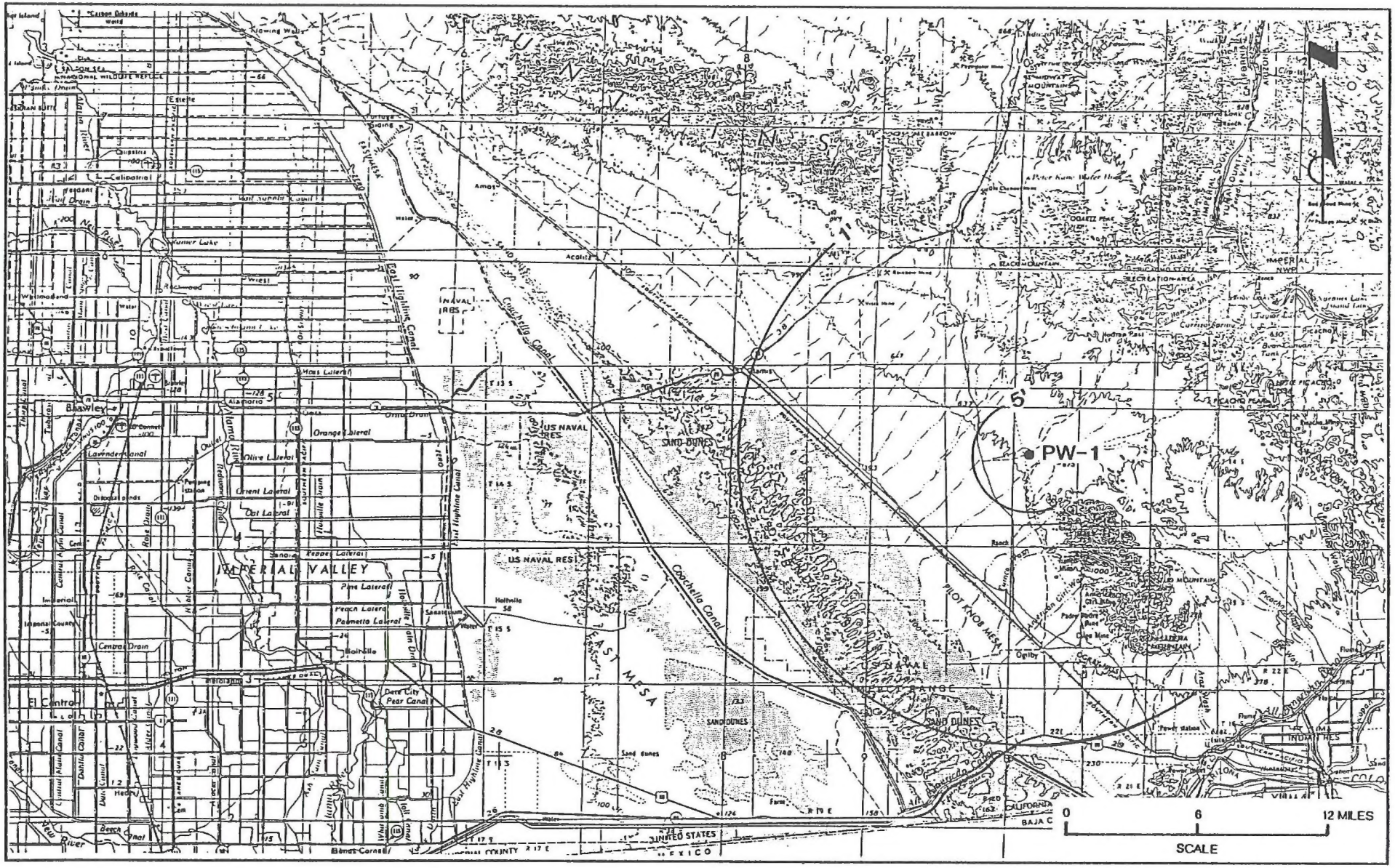


WESTEC®

FIGURE 5-2

PRODUCTION WELL DESIGN

CHEMGOLD, INC.
IMPERIAL PROJECT
HYDROLOGY BASELINE REPORT

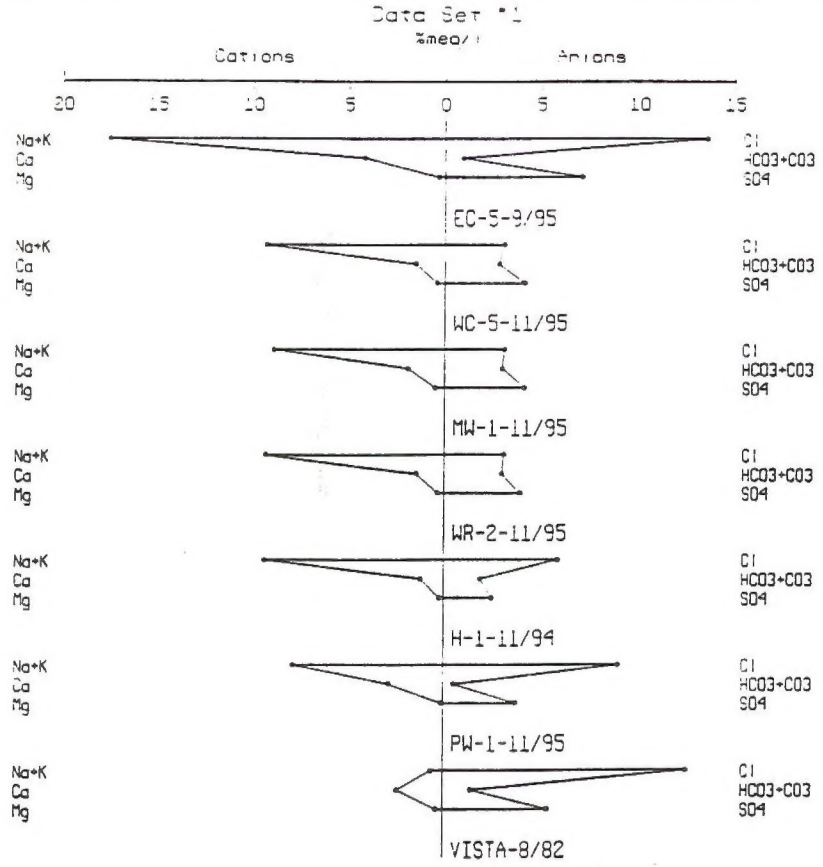


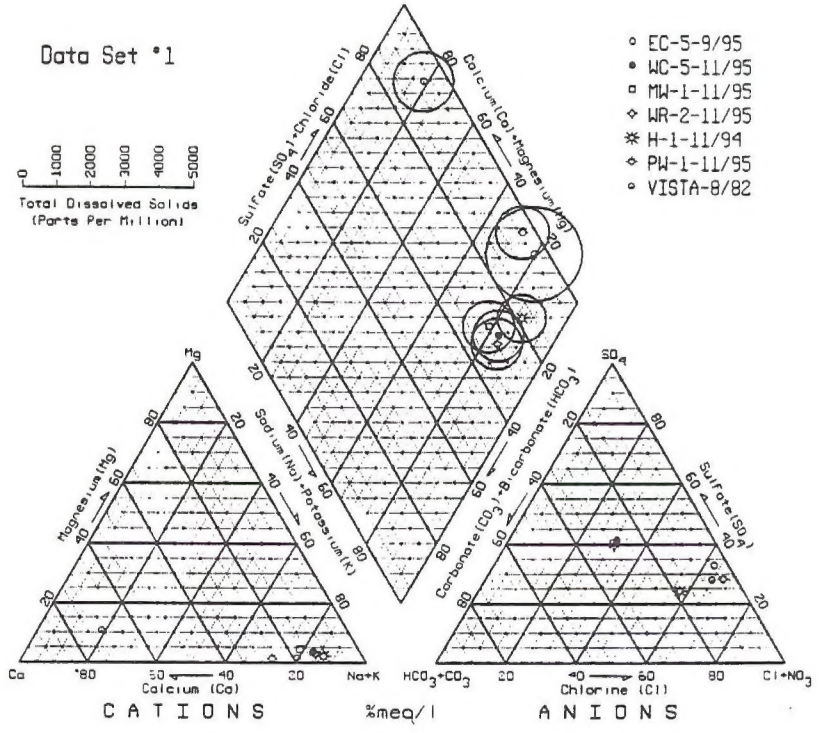
WESTEC®

FIGURE 6-1

CHEMGOLD, INC.
IMPERIAL PROJECT
HYDROLOGY BASELINE REPORT

DRAWDOWN CONTOURS WITH TRANSMISSIVITY OF 8,000 FT²/DAY





WESTEC®

FIGURE 7-1

CHEMGOLD, INC.
IMPERIAL PROJECT
HYDROLOGY BASELINE REPORT

STIFF AND PIPER DIAGRAMS

APPENDIX A

FALLING HEAD / SLUG TEST

FALLING HEAD TEST AND SLUG TEST DATA ANALYSIS

1. **Falling Head Test**

Permeability values were calculated using the following equation:

$$K = [(r^2/L) \ln(L/R) / t] [dh / (H_2 + H_1)]$$

where K = permeability (ft/sec)
r = pipe radius (ft)
L = screen intake (ft)
R = hole radius (ft)
t = time (sec)
dh = head drop (ft)
H_1 = begining head (ft)
H_2 = ending head (ft)

Well WC-5 Average calculated K = 4.6E-08 ft/sec (1.4E-06 cm/sec)

Test 1

Pipe Diameter (in): 1.3
Hole Diameter (in): 6
Screen Interval (ft): 40

r (ft) = 0.054167
R (ft) = 0.25
L (ft) = 40

Time (sec)	Elapsed Time (sec)	Fld Measd Wtr Level (ft)	DTW (ft)	Head Drop (ft)	H1 (ft)	H2 (ft)	K (ft/sec)	K (cm/sec)
0	0	0	613.3					
16	16	3	610.3	3	613.3	610.3	5.7E-08	1.7E-06
21	5	4	609.3	1.0	610.3	609.3	6.1E-08	1.9E-06
29	8	5.3	606	1.3	609.3	608	5.0E-08	1.5E-06
34	5	6	607.3	0.7	608	607.3	4.3E-08	1.3E-06
40	6	7	606.3	1	607.3	606.3	5.1E-08	1.6E-06
46	6	8	605.3	1	606.3	605.3	5.1E-08	1.6E-06
54	8	9	604.3	1	605.3	604.3	3.9E-08	1.2E-06
60	6	10	603.3	1	604.3	603.3	5.1E-08	1.6E-06
67	7	11	602.3	1	603.3	602.3	4.4E-08	1.3E-06
75	8	12	601.3	1	602.3	601.3	3.9E-08	1.2E-06
83	8	13	600.3	1	601.3	600.3	3.9E-08	1.2E-06
91	8	14	599.3	1	600.3	599.3	3.9E-08	1.2E-06
100	9	15	596.3	1	599.3	596.3	3.5E-08	1.1E-06
109	9	16	597.3	1	598.3	597.3	3.5E-08	1.1E-06
118	9	17	596.3	1	597.3	596.3	3.5E-08	1.1E-06
127	9	18	595.3	1	596.3	595.3	3.5E-08	1.1E-06
136	9	19	594.3	1	595.3	594.3	3.5E-08	1.1E-06
154	18	21	592.3	2	594.3	592.3	3.5E-08	1.1E-06
174	20	23	590.3	2	592.3	590.3	3.1E-08	9.6E-07
193	19	25	588.3	2	590.3	588.3	3.3E-08	1.0E-06
242	49	30	583.3	5	588.3	583.3	3.2E-08	9.9E-07
						AVE:	4.1E-08	1.3E-06

Test 2

Pipe Diameter (in):	1.3	r (ft) =	0.054167
Hole Diameter (in):	6	R (ft) =	0.25
Screen Interval (ft):	40	L (ft) =	40

Time (sec)	Elapsed Time (sec)	Fld Measd Wtr Level (ft)	DTW (ft)	Head Drop (ft)	H1 (ft)	H2 (ft)	K (ft/sec)	K (cm/sec)
0	0	0	613.3					
21	21	1.1	612.2	1.1	613.3	612.2	1.6E-08	4.8E-07
31	10	1.7	611.6	0.6	612.2	611.6	1.8E-08	5.6E-07
48	17	2.1	611.2	0.4	611.6	611.2	7.2E-09	2.2E-07
58	10	2.6	610.7	0.5	611.2	610.7	1.5E-08	4.6E-07
92	34	7	606.3	4.4	610.7	606.3	4.0E-08	1.2E-06
112	20	11	602.3	4	606.3	602.3	6.2E-08	1.9E-06
150	38	18.6	594.7	7.6	602.3	594.7	6.2E-08	1.9E-06
172	22	23	590.3	4.4	594.7	590.3	6.3E-08	1.9E-06
180	8	24.5	588.3	1.5	590.3	588.8	5.9E-08	1.8E-06
194	14	28	585.3	3.5	588.8	585.3	7.9E-08	2.4E-06
206	12	30	583.3	2	585.3	583.3	5.3E-08	1.6E-06
216	10	32	581.3	2	583.3	581.3	6.4E-08	1.9E-06
						AVE:	4.5E-08	1.4E-06

Test 3

Pipe Diameter (in): 1.3
Hole Diameter (in): 6
Screen Interval (ft): 40

r (ft) = 0.054167
R (ft) = 0.25
L (ft) = 40

Time (sec)	Elapsed Time (sec)	Fld Measd Wtr Level (ft)	DTW (ft)	Head Drop (ft)	H1 (ft)	H2 (ft)	K (ft/sec)	K (cm/sec)
0	0	0	613.3					
13	13	2.5	610.8	2.5	613.3	610.8	5.8E-08	1.8E-06
26	13	5.5	607.8	3	610.8	607.8	7.0E-08	2.2E-06
46	20	9.5	603.8	4	607.8	603.8	6.1E-08	1.9E-06
50	4	11	602.3	1.5	603.8	602.3	1.2E-07	3.5E-06
58	8	12.5	600.8	1.5	602.3	600.8	5.8E-08	1.8E-06
64	6	13.5	599.8	1	600.8	599.8	5.2E-08	1.6E-06
66	2	14.5	598.8	1	599.8	598.8	1.6E-07	4.7E-06
73	7	16	597.3	1.5	598.8	597.3	6.7E-08	2.0E-06
77	4	17	596.3	1	597.3	596.3	7.8E-08	2.4E-06
87	10	19	594.3	2	596.3	594.3	6.3E-08	1.9E-06
152	65	32	581.3	13	594.3	581.3	6.3E-08	1.9E-06
						AVE:	7.5E-08	2.3E-06

Test 4

Pipe Diameter (in):	1.3	r (ft) =	0.054167
Hole Diameter (in):	6	R (ft) =	0.25
Screen Interval (ft):	40	L (ft) =	40

Time (sec)	Elapsed Time (sec)	Fld Measd Wtr Level (ft)	DTW (ft)	Head Drop (ft)	H1 (ft)	H2 (ft)	K (ft/sec)	K (cm/sec)
0	0	0	613.3					
31	31	1.1	612.2	1.1	613.3	612.2	1.1E-08	3.3E-07
39	8	1.5	611.8	0.4	612.2	611.6	1.5E-08	4.6E-07
57	18	2.6	610.7	1.1	611.8	610.7	1.9E-08	5.7E-07
74	17	4	609.3	1.4	610.7	609.3	2.5E-08	7.7E-07
87	13	5	608.3	1	609.3	608.3	2.4E-08	7.2E-07
121	34	9	604.3	4	608.3	604.3	3.6E-08	1.1E-06
133	12	10	603.3	1	604.3	603.3	2.6E-08	7.8E-07
146	13	11	602.3	1	603.3	602.3	2.4E-08	7.2E-07
171	25	12	601.3	1	602.3	601.3	1.2E-08	3.8E-07
218	47	13.2	600.1	1.2	601.3	600.1	7.9E-09	2.4E-07
233	15	14.1	599.2	0.9	600.1	599.2	1.9E-08	5.7E-07
						AVE:	2.0E-08	6.0E-07

Well EC-5 Average calculated K = 1.1E-08 ft/sec (3.5E-07 cm/sec)

Test 1

Pipe Diameter (in): 1.3
Hole Diameter (in): 6
Screen Interval (ft): 40

r (ft) = 0.054167
R (ft) = 0.25
L (ft) = 40

Time (sec)	Elapsed Time (sec)	Fld Measd Wtr Level (ft)	DTW (ft)	Head Drop (ft)	H1 (ft)	H2 (ft)	K (ft/sec)	K (cm/sec)
0	0	0	693.3					
33	33	1	692.3	1	692.3	692.3	8.1E-09	2.5E-07
48	15	1.5	691.8	0.5	691.8	691.8	9.0E-09	2.7E-07
64	16	2	691.3	0.5	691.8	691.3	8.4E-09	2.6E-07
97	33	3	690.3	1	691.3	690.3	8.2E-09	2.5E-07
141	44	4.3	689	1.3	690.3	689	8.0E-09	2.4E-07
180	39	5.4	687.9	1.1	689	687.9	7.6E-09	2.3E-07
205	25	6.1	687.2	0.7	687.9	687.2	7.6E-09	2.3E-07
242	37	7.1	686.2	1	687.2	686.2	7.3E-09	2.2E-07
278	36	8.1	685.2	1	686.2	685.2	7.5E-09	2.3E-07
312	34	9	684.3	0.9	685.2	684.3	7.2E-09	2.2E-07
349	37	10	683.3	1	684.3	683.3	7.4E-09	2.2E-07
407	58	11.5	681.8	1.5	683.3	681.8	7.1E-09	2.2E-07
464	57	13	680.3	1.5	681.8	680.3	7.2E-09	2.2E-07
503	39	14	679.3	1	680.3	679.3	7.0E-09	2.1E-07
586	83	16	677.3	2	679.3	677.3	6.6E-09	2.0E-07
627	41	17	676.3	1	677.3	676.3	6.7E-09	2.0E-07
						AVE:	7.5E-09	2.3E-07

Test 2

Pipe Diameter (in):	1.3	r (ft) =	0.054167
Hole Diameter (in):	6	R (ft) =	0.25
Screen Interval (ft):	40	L (ft) =	40

Time (sec)	Elapsed Time (sec)	Fld Measd Wtr Level (ft)	DTW (ft)	Head Drop (ft)	H1 (ft)	H2 (ft)	K (ft/sec)	K (cm/sec)
0	0	0	693.3					
25	25	1.2	692.1	1.2	693.3	692.1	1.3E-08	3.9E-07
33	8	1.6	691.7	0.4	692.1	691.7	1.4E-08	4.1E-07
44	11	2.2	691.1	0.6	691.7	691.1	1.5E-08	4.5E-07
54	10	2.6	690.7	0.4	691.1	690.7	1.1E-08	3.3E-07
65	11	3	690.3	0.4	690.7	690.3	9.8E-09	3.0E-07
73	8	3.5	689.8	0.5	690.3	689.8	1.7E-08	5.1E-07
83	10	4	689.3	0.5	689.8	689.3	1.4E-08	4.1E-07
105	22	5	688.3	1	689.3	688.3	1.2E-08	3.7E-07
141	36	6.5	686.8	1.5	688.3	686.8	1.1E-08	3.4E-07
153	12	7	686.3	0.5	686.8	686.3	1.1E-08	3.4E-07
178	25	8	685.3	1	686.3	685.3	1.1E-08	3.3E-07
205	27	9	684.3	1	685.3	684.3	1.0E-08	3.1E-07
249	44	10.5	682.8	1.5	684.3	682.8	9.3E-09	2.8E-07
292	43	12	681.3	1.5	682.8	681.3	9.5E-09	2.9E-07
359	67	14	679.3	2	681.3	679.3	8.2E-09	2.5E-07
392	33	15	678.3	1	679.3	678.3	8.3E-09	2.5E-07
427	35	16	677.3	1	678.3	677.3	7.9E-09	2.4E-07
464	37	17	676.3	1	677.3	676.3	7.4E-09	2.3E-07
						AVE:	1.1E-08	3.4E-07

Test 3

Pipe Diameter (in): 1.3
Hole Diameter (in): 6
Screen Interval (ft): 40

r (ft) = 0.054167
R (ft) = 0.25
L (ft) = 40

Time (sec)	Elapsed Time (sec)	Fld Measd Wtr Level (ft)	DTW (ft)	Head Drop (ft)	H1 (ft)	H2 (ft)	K (ft/sec)	K (cm/sec)
0	0	0	693.3					
22	22	3	690.3	3	693.3	690.3	3.7E-08	1.1E-06
53	31	5.7	687.6	2.7	690.3	687.6	2.4E-08	7.2E-07
70	17	6.6	686.7	0.9	687.6	686.7	1.4E-08	4.4E-07
95	25	8	685.3	1.4	686.7	685.3	1.5E-08	4.6E-07
119	24	9.4	683.9	1.4	685.3	683.9	1.6E-08	4.8E-07
131	12	10	683.3	0.6	683.9	683.3	1.4E-08	4.2E-07
162	31	11.6	681.7	1.6	683.3	681.7	1.4E-08	4.3E-07
188	26	13	680.3	1.4	681.7	680.3	1.5E-08	4.5E-07
228	40	15	678.3	2	680.3	678.3	1.4E-08	4.2E-07
250	22	16.1	677.2	1.1	678.3	677.2	1.4E-08	4.2E-07
269	19	17	676.3	0.9	677.2	676.3	1.3E-08	4.0E-07
318	49	19.2	674.1	2.2	676.3	674.1	1.2E-08	3.8E-07
370	52	21.5	671.8	2.3	674.1	671.8	1.2E-08	3.7E-07
455	85	25	668.3	3.5	671.8	668.3	1.1E-08	3.5E-07
						AVE:	1.6E-08	4.9E-07

2. **Slug Test**

The slug test data was analyzed by the Hvorslev method as described below.

- the ratio h/H was computed, where H is the height the water level rises above the static water level immediately upon lowering the slug and h is the height of the water level above the static water level some time, t, after the slug is lowered
- the ratio h/H versus time was plotted as semi log plot
- a straight line was drawn through the data, and adjusted such that the line passed through h/H = 1.0 to account for friction effects in the well
- T_0 was determined at h/H = 0.37

Permeability was calculated using the following expression, which is applicable if the ratio L/R > 8 is satisfied.

$$K = \frac{r^2 \ln (L/R)}{2LT_0}$$

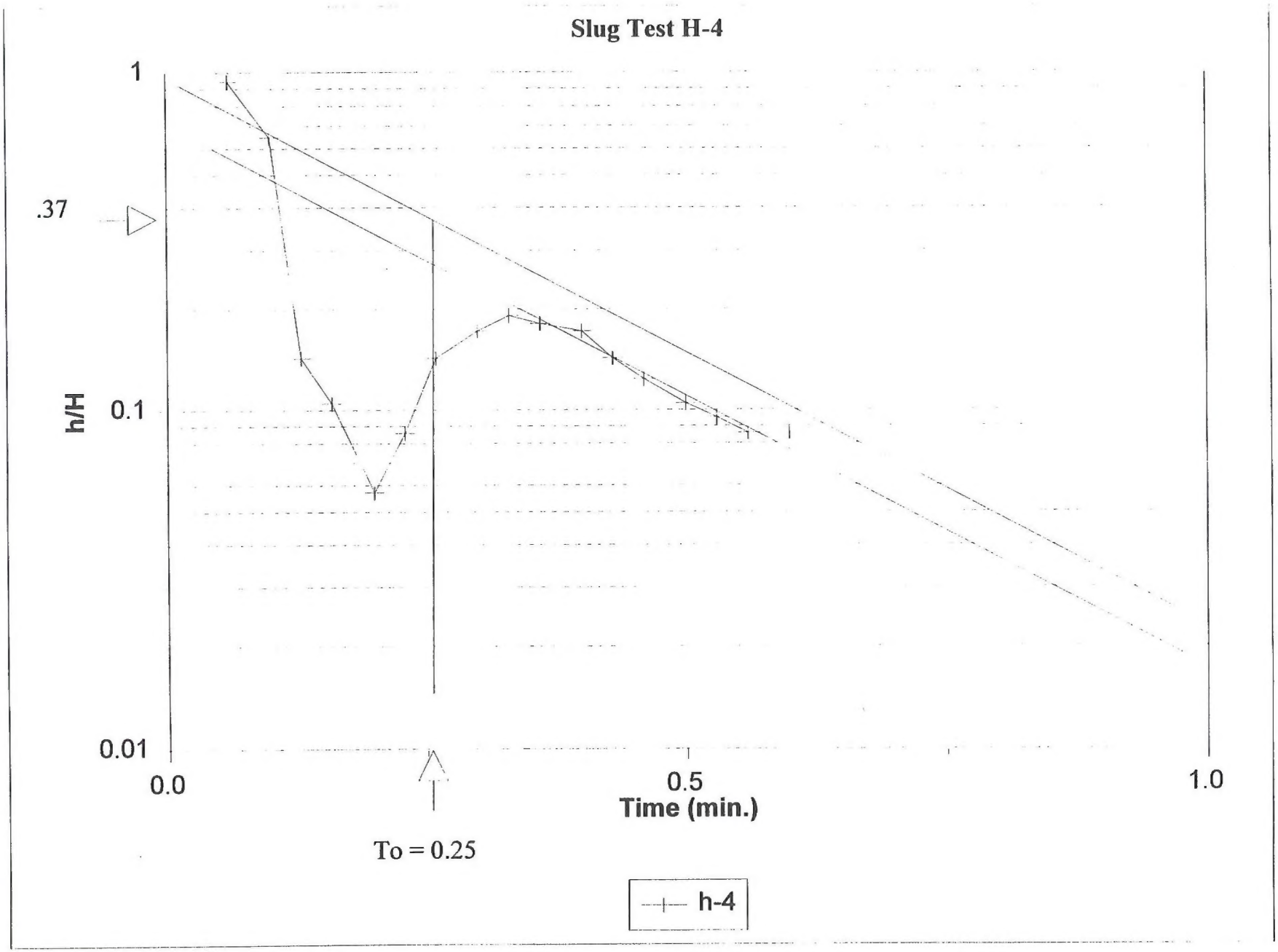
where

K is permeability
r is the radius of the well casing
R is the radius of the drill hole
L is the length of the well screen
T_0 is the time it takes for the water level to rise or fall to 37 percent of the initial change

The major assumptions made when using the Hvorslev Technique are:

- homogeneous and isotropic aquifer
- infinite medium
- soil and water are incompressible, and
- Darcy's law applies.

Determination of permeability values from the slug tests conducted in the piezometer wells by the Hvorslev technique are illustrated in the following graphs.


Slug Test H-4
1
.37
0.1
0.01
h/H
0.0
0.5
1.0
Time (min.)
To = 0.25
h-4

HVORSLEV

CHEMGOLD HOLE H-4

LENGTH OF SCREEN	L =	40	ft
HOLE RADIUS	R =	0.24	ft
PIPE RADIUS	r =	0.055	ft

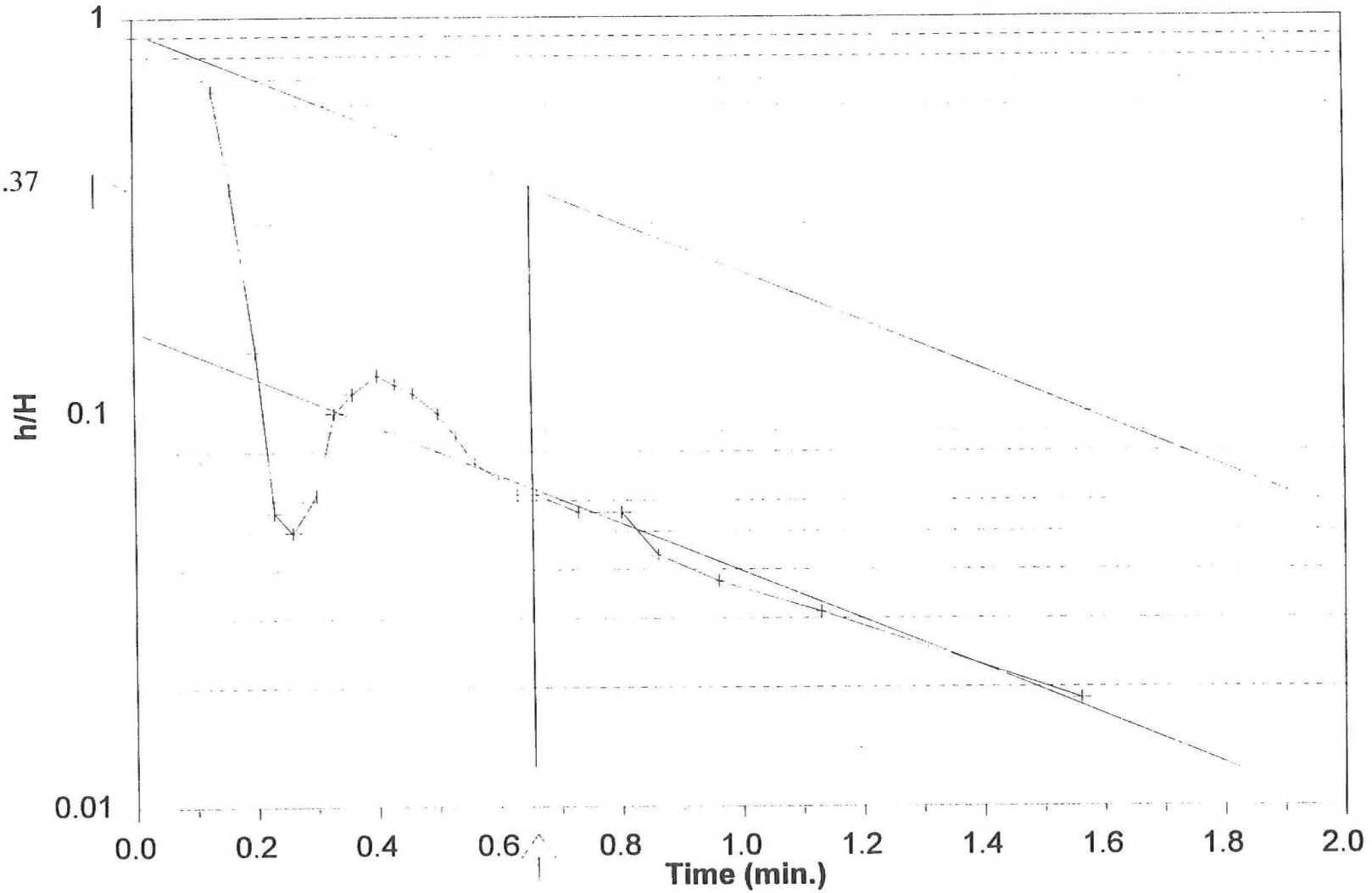
t (min)	h	h/H
0	1.05	
0.03		
0.06	0.99	0.942857
0.1	0.68	0.647619
0.13	0.15	0.142857
0.16	0.11	0.104762
0.2	0.06	0.057143
0.23	0.09	0.085714
0.26	0.15	0.142857
0.3	0.18	0.171429
0.33	0.2	0.190476
0.36	0.19	0.180952
0.4	0.18	0.171429
0.43	0.15	0.142857
0.46	0.13	0.12381
0.5	0.11	0.104762
0.53	0.1	0.095238
0.56	0.09	0.085714
0.6	0.09	0.085714

To = 0.25

K = 0.014069 ft/min

2.77E-02 cm/sec

Slug Test H-5



HVORSLEV

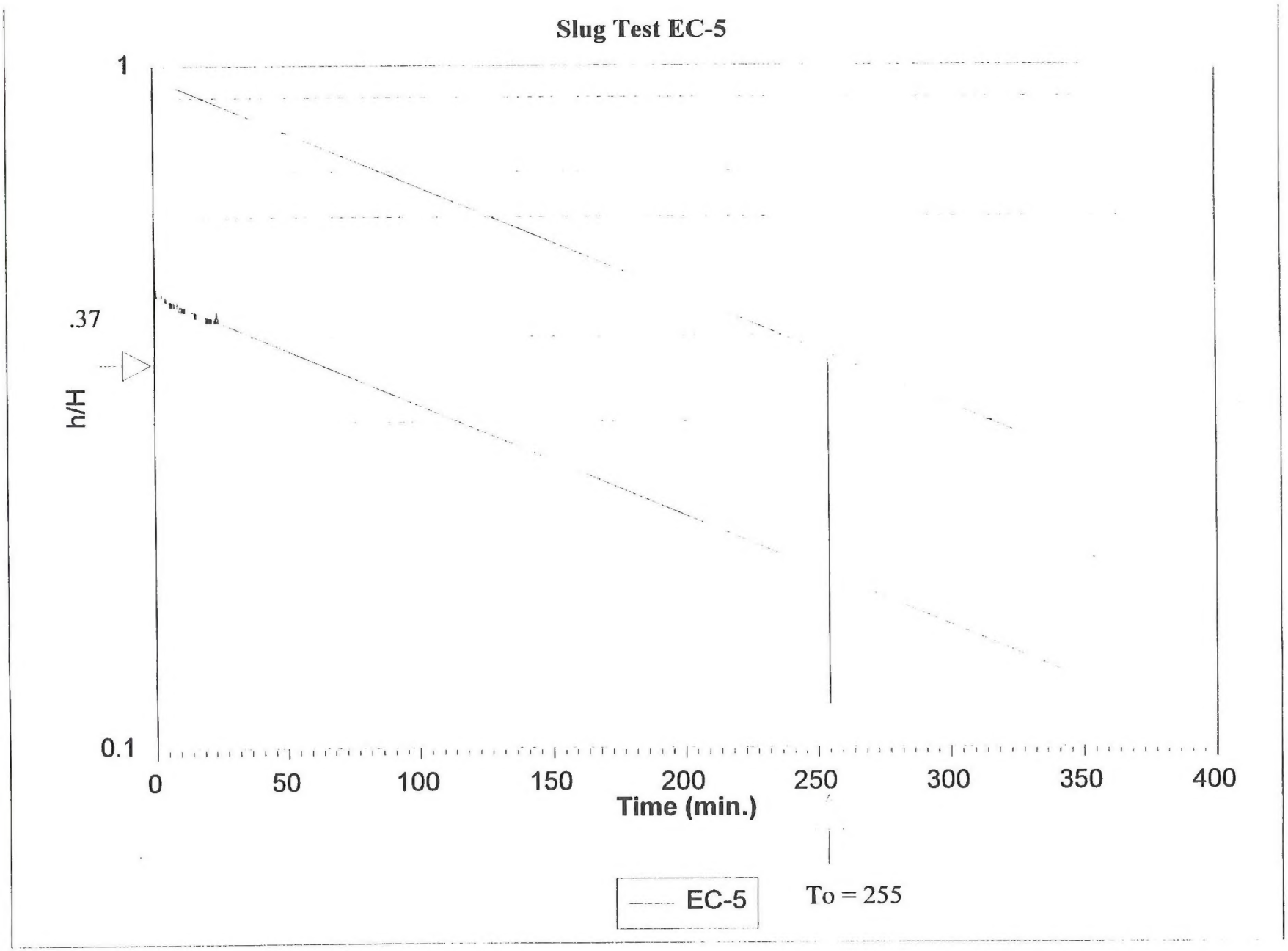
CHEMGOLD HOLE H-5

LENGTH OF SCREEN	L =	40	ft
HOLE RADIUS	R =	0.24	ft
PIPE RADIUS	r =	0.055	ft

t (min)	h	h/H
0	1.61	
0.03		
0.06	0	
0.1	0	
0.13	1.05	0.652174
0.16	0.59	0.36646
0.2	0.23	0.142857
0.23	0.09	0.055901
0.26	0.08	0.049689
0.3	0.1	0.062112
0.33	0.16	0.099379
0.36	0.18	0.111801
0.4	0.2	0.124224
0.43	0.19	0.118012
0.46	0.18	0.111801
0.5	0.16	0.099379
0.53	0.14	0.086957
0.56	0.12	0.074534
0.6	0.11	0.068323
0.63	0.1	0.062112
0.66	0.1	0.062112
0.73	0.09	0.055901
0.8	0.09	0.055901
0.86	0.07	0.043478
0.96	0.06	0.037267
1.13	0.05	0.031056
1.56	0.03	0.018634

To = 0.66

K = 0.005329 ft/min
1.05E-02 cm/sec


Slug Test EC-5
1
.37
0.1
h/H
0
50
100
150
200
250
300
350
400
Time (min.)
EC-5
To = 255

HVORSLEV

CHEMGOLD HOLE EC-5

LENGTH OF SCREEN	L =	40	ft
HOLE RADIUS	R =	0.24	ft
PIPE RADIUS	r =	0.055	ft
head	h =		ft
head	H =		ft

EC-5

t	h	h/H
0.0000	-1.200	
0.0333	-1.367	1.13916667
0.0666	-0.361	0.30083333
0.1000	-0.503	0.41916667
0.1333	-0.598	0.49833333
0.1666	-0.826	0.68833333
0.2000	-0.550	0.45833333
0.2333	-0.370	0.30833333
0.2666	-0.503	0.41916667
0.3000	-0.664	0.55333333
0.3333	-0.598	0.49833333
0.3666	-0.484	0.40333333
0.4000	-0.512	0.42666667
0.4333	-0.598	0.49833333
0.4666	-0.598	0.49833333
0.5000	-0.531	0.4425
0.5333	-0.522	0.435
0.5666	-0.569	0.47416667
0.6000	-0.579	0.4825
0.6333	-0.550	0.45833333
0.6666	-0.541	0.45083333
0.7000	-0.560	0.46666667
0.7333	-0.569	0.47416667
0.7666	-0.560	0.46666667
0.8000	-0.550	0.45833333
0.8333	-0.550	0.45833333
0.8666	-0.569	0.47416667
0.9000	-0.560	0.46666667
0.9333	-0.550	0.45833333
0.9666	-0.550	0.45833333
1.0000	-0.560	0.46666667
1.0333	-0.560	0.46666667
1.0666	-0.550	0.45833333
1.1000	-0.560	0.46666667
1.1333	-0.560	0.46666667
1.1666	-0.560	0.46666667
1.2000	-0.550	0.45833333
1.2333	-0.550	0.45833333
1.2666	-0.560	0.46666667
1.3000	-0.550	0.45833333
1.3333	-0.550	0.45833333
1.3666	-0.560	0.46666667

1.4000	-0.550	0.45833333
1.4333	-0.550	0.45833333
1.4666	-0.550	0.45833333
1.5000	-0.550	0.45833333
1.5333	-0.550	0.45833333
1.5666	-0.550	0.45833333
1.6000	-0.550	0.45833333
1.6333	-0.550	0.45833333
1.6666	-0.550	0.45833333
1.7000	-0.550	0.45833333
1.7333	-0.550	0.45833333
1.7666	-0.550	0.45833333
1.8000	-0.550	0.45833333
1.8333	-0.560	0.46666667
1.8666	-0.550	0.45833333
1.9000	-0.550	0.45833333
1.9333	-0.550	0.45833333
1.9666	-0.550	0.45833333
2.0000	-0.550	0.45833333
2.0333	-0.550	0.45833333
2.0666	-0.550	0.45833333
2.1000	-0.550	0.45833333
2.1333	-0.550	0.45833333
2.1666	-0.550	0.45833333
2.2000	-0.550	0.45833333
2.2333	-0.550	0.45833333
2.2666	-0.550	0.45833333
2.3000	-0.560	0.46666667
2.3333	-0.550	0.45833333
2.3666	-0.550	0.45833333
2.4000	-0.550	0.45833333
2.4333	-0.550	0.45833333
2.4666	-0.550	0.45833333
2.5000	-0.550	0.45833333
2.5333	-0.550	0.45833333
2.5666	-0.550	0.45833333
2.6000	-0.550	0.45833333
2.6333	-0.550	0.45833333
2.6666	-0.550	0.45833333
2.7000	-0.550	0.45833333
2.7333	-0.550	0.45833333
2.7666	-0.550	0.45833333
2.8000	-0.550	0.45833333
2.8333	-0.550	0.45833333
2.8666	-0.550	0.45833333
2.9000	-0.550	0.45833333
2.9333	-0.550	0.45833333
2.9666	-0.560	0.46666667
3.0000	-0.550	0.45833333
3.0333	-0.550	0.45833333
3.0666	-0.550	0.45833333
3.1000	-0.550	0.45833333
3.1333	-0.550	0.45833333
3.1666	-0.550	0.45833333
3.2000	-0.550	0.45833333
3.2333	-0.550	0.45833333
3.2666	-0.550	0.45833333
3.3000	-0.550	0.45833333
3.3333	-0.550	0.45833333
3.3666	-0.550	0.45833333
3.4000	-0.550	0.45833333

3.4333	-0.550	0.45833333
3.4666	-0.550	0.45833333
3.5000	-0.550	0.45833333
3.5333	-0.550	0.45833333
3.5666	-0.550	0.45833333
3.6000	-0.550	0.45833333
3.6333	-0.550	0.45833333
3.6666	-0.550	0.45833333
3.7000	-0.550	0.45833333
3.7333	-0.550	0.45833333
3.7666	-0.550	0.45833333
3.8000	-0.550	0.45833333
3.8333	-0.550	0.45833333
3.8666	-0.550	0.45833333
3.9000	-0.550	0.45833333
3.9333	-0.550	0.45833333
3.9666	-0.550	0.45833333
4.0000	-0.550	0.45833333
4.0333	-0.550	0.45833333
4.0666	-0.550	0.45833333
4.1000	-0.550	0.45833333
4.1333	-0.550	0.45833333
4.1666	-0.541	0.45083333
4.2000	-0.541	0.45083333
4.2333	-0.550	0.45833333
4.2666	-0.541	0.45083333
4.3000	-0.541	0.45083333
4.3333	-0.550	0.45833333
4.3666	-0.550	0.45833333
4.4000	-0.541	0.45083333
4.4333	-0.550	0.45833333
4.4666	-0.541	0.45083333
4.5000	-0.541	0.45083333
4.5333	-0.541	0.45083333
4.5666	-0.541	0.45083333
4.6000	-0.541	0.45083333
4.6333	-0.541	0.45083333
4.6666	-0.541	0.45083333
4.7000	-0.541	0.45083333
4.7333	-0.541	0.45083333
4.7666	-0.550	0.45833333
4.8000	-0.541	0.45083333
4.8333	-0.541	0.45083333
4.8666	-0.541	0.45083333
4.9000	-0.541	0.45083333
4.9333	-0.541	0.45083333
4.9666	-0.541	0.45083333
5.0000	-0.541	0.45083333
5.0333	-0.541	0.45083333
5.0666	-0.541	0.45083333
5.1000	-0.541	0.45083333
5.1333	-0.541	0.45083333
5.1666	-0.541	0.45083333
5.2000	-0.541	0.45083333
5.2333	-0.541	0.45083333
5.2666	-0.541	0.45083333
5.3000	-0.541	0.45083333
5.3333	-0.541	0.45083333
5.3666	-0.541	0.45083333
5.4000	-0.541	0.45083333
5.4333	-0.541	0.45083333

5.4666	-0.541	0.45083333
5.5000	-0.541	0.45083333
5.5333	-0.541	0.45083333
5.5666	-0.541	0.45083333
5.6000	-0.541	0.45083333
5.6333	-0.541	0.45083333
5.6666	-0.541	0.45083333
5.7000	-0.541	0.45083333
5.7333	-0.541	0.45083333
5.7666	-0.541	0.45083333
5.8000	-0.541	0.45083333
5.8333	-0.541	0.45083333
5.8666	-0.541	0.45083333
5.9000	-0.541	0.45083333
5.9333	-0.531	0.4425
5.9666	-0.541	0.45083333
6.0000	-0.541	0.45083333
6.0333	-0.541	0.45083333
6.0666	-0.531	0.4425
6.1000	-0.541	0.45083333
6.1333	-0.541	0.45083333
6.1666	-0.531	0.4425
6.2000	-0.531	0.4425
6.2333	-0.541	0.45083333
6.2666	-0.541	0.45083333
6.3000	-0.531	0.4425
6.3333	-0.541	0.45083333
6.3666	-0.541	0.45083333
6.4000	-0.541	0.45083333
6.4333	-0.531	0.4425
6.4666	-0.541	0.45083333
6.5000	-0.541	0.45083333
6.5333	-0.541	0.45083333
6.5666	-0.531	0.4425
6.6000	-0.531	0.4425
6.6333	-0.541	0.45083333
6.6666	-0.531	0.4425
6.7000	-0.541	0.45083333
6.7333	-0.531	0.4425
6.7666	-0.531	0.4425
6.8000	-0.541	0.45083333
6.8333	-0.531	0.4425
6.8666	-0.531	0.4425
6.9000	-0.531	0.4425
6.9333	-0.531	0.4425
6.9666	-0.531	0.4425
7.0000	-0.531	0.4425
7.0333	-0.531	0.4425
7.0666	-0.531	0.4425
7.1000	-0.531	0.4425
7.1333	-0.541	0.45083333
7.1666	-0.531	0.4425
7.2000	-0.531	0.4425
7.2333	-0.531	0.4425
7.2666	-0.531	0.4425
7.3000	-0.531	0.4425
7.3333	-0.531	0.4425
7.3666	-0.531	0.4425
7.4000	-0.531	0.4425
7.4333	-0.531	0.4425
7.4666	-0.531	0.4425

7.5000	-0.531	0.4425
7.5333	-0.531	0.4425
7.5666	-0.531	0.4425
7.6000	-0.531	0.4425
7.6333	-0.531	0.4425
7.6666	-0.541	0.45083333
7.7000	-0.531	0.4425
7.7333	-0.531	0.4425
7.7666	-0.531	0.4425
7.8000	-0.531	0.4425
7.8333	-0.531	0.4425
7.8666	-0.531	0.4425
7.9000	-0.531	0.4425
7.9333	-0.531	0.4425
7.9666	-0.531	0.4425
8.0000	-0.531	0.4425
8.0333	-0.531	0.4425
8.0666	-0.531	0.4425
8.1000	-0.531	0.4425
8.1333	-0.531	0.4425
8.1666	-0.531	0.4425
8.2000	-0.531	0.4425
8.2333	-0.531	0.4425
8.2666	-0.531	0.4425
8.3000	-0.531	0.4425
8.3333	-0.531	0.4425
8.3666	-0.531	0.4425
8.4000	-0.531	0.4425
8.4333	-0.531	0.4425
8.4666	-0.531	0.4425
8.5000	-0.531	0.4425
8.5333	-0.531	0.4425
8.5666	-0.531	0.4425
8.6000	-0.531	0.4425
8.6333	-0.531	0.4425
8.6666	-0.531	0.4425
8.7000	-0.541	0.45083333
8.7333	-0.531	0.4425
8.7666	-0.531	0.4425
8.8000	-0.531	0.4425
8.8333	-0.531	0.4425
8.8666	-0.531	0.4425
8.9000	-0.531	0.4425
8.9333	-0.531	0.4425
8.9666	-0.531	0.4425
9.0000	-0.531	0.4425
9.0333	-0.531	0.4425
9.0666	-0.531	0.4425
9.1000	-0.531	0.4425
9.1333	-0.531	0.4425
9.1666	-0.531	0.4425
9.2000	-0.531	0.4425
9.2333	-0.531	0.4425
9.2666	-0.531	0.4425
9.3000	-0.531	0.4425
9.3333	-0.531	0.4425
9.3666	-0.531	0.4425
9.4000	-0.531	0.4425
9.4333	-0.531	0.4425
9.4666	-0.531	0.4425
9.5000	-0.531	0.4425

9.5333	-0.531	0.4425
9.5666	-0.522	0.435
9.6000	-0.531	0.4425
9.6333	-0.531	0.4425
9.6666	-0.531	0.4425
9.7000	-0.531	0.4425
9.7333	-0.531	0.4425
9.7666	-0.531	0.4425
9.8000	-0.531	0.4425
9.8333	-0.531	0.4425
9.8666	-0.531	0.4425
9.9000	-0.531	0.4425
9.9333	-0.531	0.4425
9.9666	-0.522	0.435
10.0000	-0.531	0.4425
10.0333	-0.531	0.4425
10.0667	-0.531	0.4425
10.1000	-0.531	0.4425
10.1333	-0.531	0.4425
10.1667	-0.531	0.4425
10.2000	-0.531	0.4425
10.2333	-0.531	0.4425
10.2667	-0.531	0.4425
10.3000	-0.531	0.4425
10.3333	-0.531	0.4425
10.3667	-0.531	0.4425
10.4000	-0.531	0.4425
10.4333	-0.531	0.4425
10.4667	-0.522	0.435
10.5000	-0.531	0.4425
10.5333	-0.531	0.4425
10.5667	-0.522	0.435
10.6000	-0.531	0.4425
10.6333	-0.531	0.4425
10.6667	-0.531	0.4425
10.7000	-0.522	0.435
10.7333	-0.522	0.435
10.7667	-0.531	0.4425
10.8000	-0.531	0.4425
10.8333	-0.531	0.4425
10.8667	-0.522	0.435
10.9000	-0.531	0.4425
10.9333	-0.522	0.435
10.9667	-0.531	0.4425
11.0000	-0.531	0.4425
11.0333	-0.531	0.4425
11.0667	-0.531	0.4425
11.1000	-0.522	0.435
11.1333	-0.522	0.435
11.1667	-0.531	0.4425
11.2000	-0.522	0.435
11.2333	-0.522	0.435
11.2667	-0.531	0.4425
11.3000	-0.522	0.435
11.3333	-0.531	0.4425
11.3667	-0.531	0.4425
11.4000	-0.522	0.435
11.4333	-0.531	0.4425
11.4667	-0.531	0.4425
11.5000	-0.522	0.435
11.5333	-0.522	0.435

11.5667	-0.522	0.435
11.6000	-0.522	0.435
11.6333	-0.531	0.4425
11.6667	-0.531	0.4425
11.7000	-0.522	0.435
11.7333	-0.531	0.4425
11.7667	-0.531	0.4425
11.8000	-0.531	0.4425
11.8333	-0.531	0.4425
11.8667	-0.522	0.435
11.9000	-0.531	0.4425
11.9333	-0.522	0.435
11.9667	-0.522	0.435
12.0000	-0.522	0.435
12.0333	-0.522	0.435
12.0667	-0.522	0.435
12.1000	-0.522	0.435
12.1333	-0.522	0.435
12.1667	-0.522	0.435
12.2000	-0.522	0.435
12.2333	-0.522	0.435
12.2667	-0.522	0.435
12.3000	-0.522	0.435
12.3333	-0.522	0.435
12.3667	-0.522	0.435
12.4000	-0.522	0.435
12.4333	-0.522	0.435
12.4667	-0.522	0.435
12.5000	-0.522	0.435
12.5333	-0.522	0.435
12.5667	-0.522	0.435
12.6000	-0.522	0.435
12.6333	-0.522	0.435
12.6667	-0.522	0.435
12.7000	-0.522	0.435
12.7333	-0.522	0.435
12.7667	-0.522	0.435
12.8000	-0.522	0.435
12.8333	-0.522	0.435
12.8667	-0.522	0.435
12.9000	-0.522	0.435
12.9333	-0.522	0.435
12.9667	-0.522	0.435
13.0000	-0.522	0.435
13.0333	-0.522	0.435
13.0667	-0.522	0.435
13.1000	-0.522	0.435
13.1333	-0.522	0.435
13.1667	-0.522	0.435
13.2000	-0.522	0.435
13.2333	-0.522	0.435
13.2667	-0.522	0.435
13.3000	-0.522	0.435
13.3333	-0.522	0.435
13.3667	-0.522	0.435
13.4000	-0.522	0.435
13.4333	-0.522	0.435
13.4667	-0.522	0.435
13.5000	-0.522	0.435
13.5333	-0.522	0.435
13.5667	-0.522	0.435

13.6000	-0.522	0.435
13.6333	-0.522	0.435
13.6667	-0.522	0.435
13.7000	-0.522	0.435
13.7333	-0.522	0.435
13.7667	-0.522	0.435
13.8000	-0.522	0.435
13.8333	-0.522	0.435
13.8667	-0.522	0.435
13.9000	-0.522	0.435
13.9333	-0.522	0.435
13.9667	-0.522	0.435
14.0000	-0.522	0.435
14.0333	-0.522	0.435
14.0667	-0.522	0.435
14.1000	-0.522	0.435
14.1333	-0.522	0.435
14.1667	-0.522	0.435
14.2000	-0.522	0.435
14.2333	-0.522	0.435
14.2667	-0.522	0.435
14.3000	-0.522	0.435
14.3333	-0.522	0.435
14.3667	-0.522	0.435
14.4000	-0.522	0.435
14.4333	-0.522	0.435
14.4667	-0.522	0.435
14.5000	-0.522	0.435
14.5333	-0.522	0.435
14.5667	-0.522	0.435
14.6000	-0.522	0.435
14.6333	-0.522	0.435
14.6667	-0.522	0.435
14.7000	-0.522	0.435
14.7333	-0.522	0.435
14.7667	-0.522	0.435
14.8000	-0.522	0.435
14.8333	-0.522	0.435
14.8667	-0.522	0.435
14.9000	-0.522	0.435
14.9333	-0.522	0.435
14.9667	-0.522	0.435
15.0000	-0.522	0.435
15.0333	-0.522	0.435
15.0667	-0.522	0.435
15.1000	-0.522	0.435
15.1333	-0.522	0.435
15.1667	-0.522	0.435
15.2000	-0.522	0.435
15.2333	-0.522	0.435
15.2667	-0.522	0.435
15.3000	-0.522	0.435
15.3333	-0.522	0.435
15.3667	-0.522	0.435
15.4000	-0.512	0.42666667
15.4333	-0.522	0.435
15.4667	-0.512	0.42666667
15.5000	-0.522	0.435
15.5333	-0.522	0.435
15.5667	-0.512	0.42666667
15.6000	-0.512	0.42666667

15.6333	-0.522	0.435
15.6667	-0.512	0.42666667
15.7000	-0.522	0.435
15.7333	-0.522	0.435
15.7667	-0.512	0.42666667
15.8000	-0.512	0.42666667
15.8333	-0.512	0.42666667
15.8667	-0.512	0.42666667
15.9000	-0.512	0.42666667
15.9333	-0.522	0.435
15.9667	-0.512	0.42666667
16.0000	-0.512	0.42666667
16.0333	-0.512	0.42666667
16.0667	-0.512	0.42666667
16.1000	-0.512	0.42666667
16.1333	-0.512	0.42666667
16.1667	-0.512	0.42666667
16.2000	-0.512	0.42666667
16.2333	-0.512	0.42666667
16.2667	-0.512	0.42666667
16.3000	-0.512	0.42666667
16.3333	-0.512	0.42666667
16.3667	-0.512	0.42666667
16.4000	-0.512	0.42666667
16.4333	-0.512	0.42666667
16.4667	-0.512	0.42666667
16.5000	-0.512	0.42666667
16.5333	-0.512	0.42666667
16.5667	-0.512	0.42666667
16.6000	-0.512	0.42666667
16.6333	-0.512	0.42666667
16.6667	-0.512	0.42666667
16.7000	-0.512	0.42666667
16.7333	-0.512	0.42666667
16.7667	-0.512	0.42666667
16.8000	-0.512	0.42666667
16.8333	-0.512	0.42666667
16.8667	-0.512	0.42666667
16.9000	-0.512	0.42666667
16.9333	-0.512	0.42666667
16.9667	-0.512	0.42666667
17.0000	-0.512	0.42666667
17.0333	-0.512	0.42666667
17.0667	-0.512	0.42666667
17.1000	-0.512	0.42666667
17.1333	-0.512	0.42666667
17.1667	-0.512	0.42666667
17.2000	-0.512	0.42666667
17.2333	-0.512	0.42666667
17.2667	-0.512	0.42666667
17.3000	-0.512	0.42666667
17.3333	-0.512	0.42666667
17.3667	-0.512	0.42666667
17.4000	-0.512	0.42666667
17.4333	-0.512	0.42666667
17.4667	-0.512	0.42666667
17.5000	-0.512	0.42666667
17.5333	-0.512	0.42666667
17.5667	-0.512	0.42666667
17.6000	-0.512	0.42666667
17.6333	-0.512	0.42666667

17.6667	-0.512	0.42666667
17.7000	-0.512	0.42666667
17.7333	-0.512	0.42666667
17.7667	-0.512	0.42666667
17.8000	-0.512	0.42666667
17.8333	-0.512	0.42666667
17.8667	-0.512	0.42666667
17.9000	-0.512	0.42666667
17.9333	-0.512	0.42666667
17.9667	-0.512	0.42666667
18.0000	-0.512	0.42666667
18.0333	-0.512	0.42666667
18.0667	-0.512	0.42666667
18.1000	-0.512	0.42666667
18.1333	-0.512	0.42666667
18.1667	-0.512	0.42666667
18.2000	-0.512	0.42666667
18.2333	-0.512	0.42666667
18.2667	-0.512	0.42666667
18.3000	-0.512	0.42666667
18.3333	-0.512	0.42666667
18.3667	-0.512	0.42666667
18.4000	-0.512	0.42666667
18.4333	-0.512	0.42666667
18.4667	-0.512	0.42666667
18.5000	-0.512	0.42666667
18.5333	-0.512	0.42666667
18.5667	-0.512	0.42666667
18.6000	-0.512	0.42666667
18.6333	-0.512	0.42666667
18.6667	-0.512	0.42666667
18.7000	-0.512	0.42666667
18.7333	-0.512	0.42666667
18.7667	-0.512	0.42666667
18.8000	-0.512	0.42666667
18.8333	-0.512	0.42666667
18.8667	-0.512	0.42666667
18.9000	-0.512	0.42666667
18.9333	-0.512	0.42666667
18.9667	-0.512	0.42666667
19.0000	-0.512	0.42666667
19.0333	-0.512	0.42666667
19.0667	-0.512	0.42666667
19.1000	-0.512	0.42666667
19.1333	-0.512	0.42666667
19.1667	-0.512	0.42666667
19.2000	-0.512	0.42666667
19.2333	-0.512	0.42666667
19.2667	-0.512	0.42666667
19.3000	-0.512	0.42666667
19.3333	-0.512	0.42666667
19.3667	-0.512	0.42666667
19.4000	-0.512	0.42666667
19.4333	-0.512	0.42666667
19.4667	-0.512	0.42666667
19.5000	-0.512	0.42666667
19.5333	-0.512	0.42666667
19.5667	-0.512	0.42666667
19.6000	-0.512	0.42666667
19.6333	-0.512	0.42666667
19.6667	-0.512	0.42666667

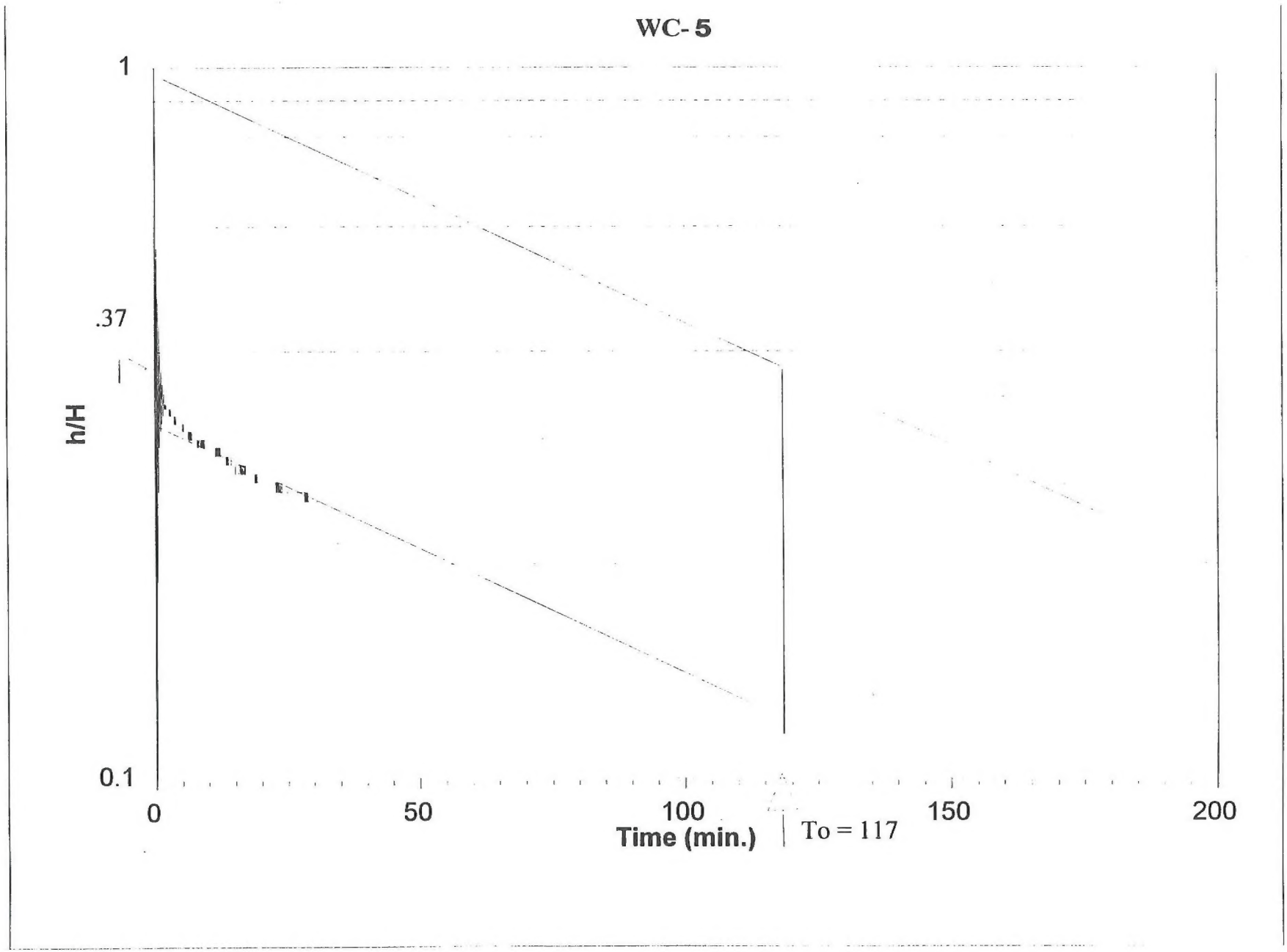
19.7000	-0.512	0.42666667
19.7333	-0.512	0.42666667
19.7667	-0.512	0.42666667
19.8000	-0.512	0.42666667
19.8333	-0.512	0.42666667
19.8667	-0.512	0.42666667
19.9000	-0.512	0.42666667
19.9333	-0.503	0.41916667
19.9667	-0.512	0.42666667
20.0000	-0.512	0.42666667
20.0333	-0.512	0.42666667
20.0667	-0.503	0.41916667
20.1000	-0.512	0.42666667
20.1333	-0.512	0.42666667
20.1667	-0.512	0.42666667
20.2000	-0.512	0.42666667
20.2333	-0.512	0.42666667
20.2667	-0.512	0.42666667
20.3000	-0.512	0.42666667
20.3333	-0.512	0.42666667
20.3667	-0.512	0.42666667
20.4000	-0.503	0.41916667
20.4333	-0.503	0.41916667
20.4667	-0.512	0.42666667
20.5000	-0.512	0.42666667
20.5333	-0.512	0.42666667
20.5667	-0.512	0.42666667
20.6000	-0.512	0.42666667
20.6333	-0.512	0.42666667
20.6667	-0.512	0.42666667
20.7000	-0.512	0.42666667
20.7333	-0.512	0.42666667
20.7667	-0.512	0.42666667
20.8000	-0.512	0.42666667
20.8333	-0.503	0.41916667
20.8667	-0.512	0.42666667
20.9000	-0.503	0.41916667
20.9333	-0.512	0.42666667
20.9667	-0.512	0.42666667
21.0000	-0.503	0.41916667
21.0333	-0.503	0.41916667
21.0667	-0.512	0.42666667
21.1000	-0.512	0.42666667
21.1333	-0.512	0.42666667
21.1667	-0.512	0.42666667
21.2000	-0.503	0.41916667
21.2333	-0.512	0.42666667
21.2667	-0.512	0.42666667
21.3000	-0.512	0.42666667
21.3333	-0.503	0.41916667
21.3667	-0.512	0.42666667
21.4000	-0.512	0.42666667
21.4333	-0.503	0.41916667
21.4667	-0.512	0.42666667
21.5000	-0.503	0.41916667
21.5333	-0.503	0.41916667
21.5667	-0.512	0.42666667
21.6000	-0.503	0.41916667
21.6333	-0.512	0.42666667
21.6667	-0.503	0.41916667
21.7000	-0.512	0.42666667

21.7333	-0.503	0.41916667
21.7667	-0.503	0.41916667
21.8000	-0.503	0.41916667
21.8333	-0.503	0.41916667
21.8667	-0.512	0.42666667
21.9000	-0.503	0.41916667
21.9333	-0.503	0.41916667
21.9667	-0.503	0.41916667
22.0000	-0.512	0.42666667
22.0333	-0.503	0.41916667
22.0667	-0.503	0.41916667
22.1000	-0.503	0.41916667
22.1333	-0.503	0.41916667
22.1667	-0.503	0.41916667
22.2000	-0.503	0.41916667
22.2333	-0.503	0.41916667
22.2667	-0.503	0.41916667
22.3000	-0.503	0.41916667
22.3333	-0.503	0.41916667
22.3667	-0.503	0.41916667
22.4000	-0.503	0.41916667
22.4333	-0.503	0.41916667
22.4667	-0.503	0.41916667
22.5000	-0.503	0.41916667
22.5333	-0.503	0.41916667
22.5667	-0.503	0.41916667
22.6000	-0.503	0.41916667
22.6333	-0.503	0.41916667
22.6667	-0.503	0.41916667
22.7000	-0.503	0.41916667
22.7333	-0.503	0.41916667
22.7667	-0.503	0.41916667
22.8000	-0.503	0.41916667
22.8333	-0.503	0.41916667
22.8667	-0.503	0.41916667
22.9000	-0.512	0.42666667
22.9333	-0.503	0.41916667
22.9667	-0.503	0.41916667
23.0000	-0.503	0.41916667
23.0333	-0.503	0.41916667
23.0667	-0.503	0.41916667
23.1000	-0.503	0.41916667
23.1333	-0.503	0.41916667
23.1667	-0.503	0.41916667
23.2000	-0.503	0.41916667
23.2333	-0.503	0.41916667
23.2667	-0.503	0.41916667
23.3000	-0.512	0.42666667
23.3333	-0.503	0.41916667
23.3667	-0.503	0.41916667
23.4000	-0.503	0.41916667
23.4333	-0.503	0.41916667
23.4667	-0.503	0.41916667
23.5000	-0.503	0.41916667
23.5333	-0.503	0.41916667
23.5667	-0.512	0.42666667
23.6000	-0.503	0.41916667
23.6333	-0.512	0.42666667
23.6667	-0.522	0.435
23.7000	-0.522	0.435
23.7333	-0.522	0.435

23.7667	-0.512	0.42666667
23.8000	-0.522	0.435
23.8333	-0.522	0.435
23.8667	-0.512	0.42666667
23.9000	-0.512	0.42666667
23.9333	-0.512	0.42666667
23.9667	-0.512	0.42666667
24.0000	-0.512	0.42666667
24.0333	-0.512	0.42666667
24.0667	-0.512	0.42666667
24.1000	-0.512	0.42666667
24.1333	-0.512	0.42666667
24.1667	-0.503	0.41916667
24.2000	-0.512	0.42666667
24.2333	-0.512	0.42666667
24.2667	-0.503	0.41916667
24.3000	-0.512	0.42666667
24.3333	-0.512	0.42666667
24.3667	-0.503	0.41916667
24.4000	-0.503	0.41916667
24.4333	-0.503	0.41916667
24.4667	-0.512	0.42666667
24.5000	-0.512	0.42666667
24.5333	-0.503	0.41916667
24.5667	-0.503	0.41916667
24.6000	-0.503	0.41916667
24.6333	-0.503	0.41916667
24.6667	-0.503	0.41916667
24.7000	-0.503	0.41916667
24.7333	-0.503	0.41916667
24.7667	-0.503	0.41916667
24.8000	-0.503	0.41916667
24.8333	-0.503	0.41916667
24.8667	-0.503	0.41916667
24.9000	-0.503	0.41916667
24.9333	-0.503	0.41916667
24.9667	-0.503	0.41916667
25.0000	-0.503	0.41916667
25.0333	-0.503	0.41916667
25.0667	-0.503	0.41916667
25.1000	-0.503	0.41916667
25.1333	-0.503	0.41916667
25.1667	-0.503	0.41916667
25.2000	-0.503	0.41916667
25.2333	-0.503	0.41916667
25.2667	-0.503	0.41916667
25.3000	-0.503	0.41916667

To = 255

K = 7.5862E-07 ft/min
3.85E-07 cm/sec


WC- 5
1
.37
0.1
h/H
0
50
100
150
200
Time (min.)
To = 117

HVORSLEV

CHEMGOLD HOLE WC-5

WC-5

Time	h	h/H
0.0000	-1.200	
0.0333	-4.538	3.78166667
0.0666	-1.119	0.9325
0.1000	1.793	-1.49416667
0.1333	1.461	-1.2175
0.1666	-0.066	0.055
0.2000	-1.338	1.115
0.2333	-1.746	1.455
0.2666	-1.252	1.04333333
0.3000	-0.218	0.18166667
0.3333	0.436	-0.36333333
0.3666	0.445	-0.37083333
0.4000	-0.142	0.11833333
0.4333	-0.835	0.69583333
0.4666	-1.148	0.95666667
0.5000	-0.949	0.79083333
0.5333	-0.436	0.36333333
0.5666	0.009	-0.0075
0.6000	0.094	-0.07833333
0.6333	-0.189	0.1575
0.6666	-0.597	0.4975
0.7000	-0.844	0.70333333
0.7333	-0.787	0.65583333
0.7666	-0.512	0.42666667
0.8000	-0.208	0.17333333
0.8333	-0.104	0.08666667
0.8666	-0.227	0.18916667
0.9000	-0.484	0.40333333
0.9333	-0.664	0.55333333
0.9666	-0.673	0.56083333
1.0000	-0.522	0.435
1.0333	-0.322	0.26833333
1.0666	-0.227	0.18916667
1.1000	-0.275	0.22916667
1.1333	-0.427	0.35583333
1.1666	-0.560	0.46666667
1.2000	-0.588	0.49
1.2333	-0.512	0.42666667
1.2666	-0.389	0.32416667
1.3000	-0.303	0.2525
1.3333	-0.322	0.26833333
1.3666	-0.398	0.33166667
1.4000	-0.493	0.41083333
1.4333	-0.531	0.4425
1.4666	-0.493	0.41083333
1.5000	-0.417	0.3475
1.5333	-0.351	0.2925
1.5666	-0.351	0.2925
1.6000	-0.389	0.32416667
1.6333	-0.455	0.37916667

1.6666	-0.484	0.40333333
1.7000	-0.474	0.395
1.7333	-0.427	0.35583333
1.7666	-0.379	0.31583333
1.8000	-0.370	0.30833333
1.8333	-0.389	0.32416667
1.8666	-0.427	0.35583333
1.9000	-0.455	0.37916667
1.9333	-0.455	0.37916667
1.9666	-0.427	0.35583333
2.0000	-0.398	0.33166667
2.0333	-0.379	0.31583333
2.0666	-0.389	0.32416667
2.1000	-0.417	0.3475
2.1333	-0.436	0.36333333
2.1666	-0.436	0.36333333
2.2000	-0.417	0.3475
2.2333	-0.398	0.33166667
2.2666	-0.389	0.32416667
2.3000	-0.398	0.33166667
2.3333	-0.408	0.34
2.3666	-0.417	0.3475
2.4000	-0.427	0.35583333
2.4333	-0.417	0.3475
2.4666	-0.408	0.34
2.5000	-0.398	0.33166667
2.5333	-0.398	0.33166667
2.5666	-0.398	0.33166667
2.6000	-0.408	0.34
2.6333	-0.408	0.34
2.6666	-0.408	0.34
2.7000	-0.398	0.33166667
2.7333	-0.398	0.33166667
2.7666	-0.398	0.33166667
2.8000	-0.398	0.33166667
2.8333	-0.408	0.34
2.8666	-0.408	0.34
2.9000	-0.408	0.34
2.9333	-0.398	0.33166667
2.9666	-0.398	0.33166667
3.0000	-0.398	0.33166667
3.0333	-0.398	0.33166667
3.0666	-0.398	0.33166667
3.1000	-0.398	0.33166667
3.1333	-0.398	0.33166667
3.1666	-0.398	0.33166667
3.2000	-0.398	0.33166667
3.2333	-0.398	0.33166667
3.2666	-0.398	0.33166667
3.3000	-0.398	0.33166667
3.3333	-0.398	0.33166667
3.3666	-0.398	0.33166667
3.4000	-0.398	0.33166667
3.4333	-0.398	0.33166667
3.4666	-0.398	0.33166667
3.5000	-0.398	0.33166667
3.5333	-0.389	0.32416667
3.5666	-0.398	0.33166667
3.6000	-0.389	0.32416667
3.6333	-0.398	0.33166667
3.6666	-0.398	0.33166667

3.7000	-0.389	0.32416667
3.7333	-0.389	0.32416667
3.7666	-0.389	0.32416667
3.8000	-0.389	0.32416667
3.8333	-0.389	0.32416667
3.8666	-0.389	0.32416667
3.9000	-0.389	0.32416667
3.9333	-0.389	0.32416667
3.9666	-0.389	0.32416667
4.0000	-0.389	0.32416667
4.0333	-0.389	0.32416667
4.0666	-0.389	0.32416667
4.1000	-0.389	0.32416667
4.1333	-0.389	0.32416667
4.1666	-0.389	0.32416667
4.2000	-0.389	0.32416667
4.2333	-0.389	0.32416667
4.2666	-0.389	0.32416667
4.3000	-0.389	0.32416667
4.3333	-0.389	0.32416667
4.3666	-0.389	0.32416667
4.4000	-0.389	0.32416667
4.4333	-0.389	0.32416667
4.4666	-0.379	0.31583333
4.5000	-0.379	0.31583333
4.5333	-0.379	0.31583333
4.5666	-0.389	0.32416667
4.6000	-0.379	0.31583333
4.6333	-0.389	0.32416667
4.6666	-0.379	0.31583333
4.7000	-0.379	0.31583333
4.7333	-0.379	0.31583333
4.7666	-0.379	0.31583333
4.8000	-0.379	0.31583333
4.8333	-0.379	0.31583333
4.8666	-0.379	0.31583333
4.9000	-0.379	0.31583333
4.9333	-0.379	0.31583333
4.9666	-0.379	0.31583333
5.0000	-0.379	0.31583333
5.0333	-0.379	0.31583333
5.0666	-0.379	0.31583333
5.1000	-0.379	0.31583333
5.1333	-0.379	0.31583333
5.1666	-0.379	0.31583333
5.2000	-0.379	0.31583333
5.2333	-0.379	0.31583333
5.2666	-0.379	0.31583333
5.3000	-0.379	0.31583333
5.3333	-0.379	0.31583333
5.3666	-0.379	0.31583333
5.4000	-0.379	0.31583333
5.4333	-0.379	0.31583333
5.4666	-0.379	0.31583333
5.5000	-0.379	0.31583333
5.5333	-0.379	0.31583333
5.5666	-0.379	0.31583333
5.6000	-0.379	0.31583333
5.6333	-0.379	0.31583333
5.6666	-0.379	0.31583333
5.7000	-0.379	0.31583333

5.7333	-0.379	0.31583333
5.7666	-0.379	0.31583333
5.8000	-0.379	0.31583333
5.8333	-0.379	0.31583333
5.8666	-0.379	0.31583333
5.9000	-0.379	0.31583333
5.9333	-0.379	0.31583333
5.9666	-0.379	0.31583333
6.0000	-0.379	0.31583333
6.0333	-0.370	0.30833333
6.0666	-0.379	0.31583333
6.1000	-0.379	0.31583333
6.1333	-0.370	0.30833333
6.1666	-0.370	0.30833333
6.2000	-0.370	0.30833333
6.2333	-0.370	0.30833333
6.2666	-0.370	0.30833333
6.3000	-0.370	0.30833333
6.3333	-0.370	0.30833333
6.3666	-0.370	0.30833333
6.4000	-0.370	0.30833333
6.4333	-0.370	0.30833333
6.4666	-0.370	0.30833333
6.5000	-0.370	0.30833333
6.5333	-0.370	0.30833333
6.5666	-0.370	0.30833333
6.6000	-0.370	0.30833333
6.6333	-0.370	0.30833333
6.6666	-0.370	0.30833333
6.7000	-0.370	0.30833333
6.7333	-0.370	0.30833333
6.7666	-0.370	0.30833333
6.8000	-0.370	0.30833333
6.8333	-0.370	0.30833333
6.8666	-0.370	0.30833333
6.9000	-0.370	0.30833333
6.9333	-0.370	0.30833333
6.9666	-0.370	0.30833333
7.0000	-0.370	0.30833333
7.0333	-0.370	0.30833333
7.0666	-0.370	0.30833333
7.1000	-0.360	0.3
7.1333	-0.370	0.30833333
7.1666	-0.370	0.30833333
7.2000	-0.370	0.30833333
7.2333	-0.370	0.30833333
7.2666	-0.360	0.3
7.3000	-0.360	0.3
7.3333	-0.370	0.30833333
7.3666	-0.360	0.3
7.4000	-0.370	0.30833333
7.4333	-0.370	0.30833333
7.4666	-0.370	0.30833333
7.5000	-0.360	0.3
7.5333	-0.360	0.3
7.5666	-0.370	0.30833333
7.6000	-0.370	0.30833333
7.6333	-0.360	0.3
7.6666	-0.370	0.30833333
7.7000	-0.360	0.3
7.7333	-0.360	0.3

7.7666	-0.360	0.3
7.8000	-0.360	0.3
7.8333	-0.360	0.3
7.8666	-0.360	0.3
7.9000	-0.360	0.3
7.9333	-0.360	0.3
7.9666	-0.360	0.3
8.0000	-0.360	0.3
8.0333	-0.360	0.3
8.0666	-0.360	0.3
8.1000	-0.360	0.3
8.1333	-0.360	0.3
8.1666	-0.360	0.3
8.2000	-0.360	0.3
8.2333	-0.360	0.3
8.2666	-0.360	0.3
8.3000	-0.360	0.3
8.3333	-0.360	0.3
8.3666	-0.360	0.3
8.4000	-0.360	0.3
8.4333	-0.360	0.3
8.4666	-0.360	0.3
8.5000	-0.360	0.3
8.5333	-0.360	0.3
8.5666	-0.360	0.3
8.6000	-0.360	0.3
8.6333	-0.360	0.3
8.6666	-0.360	0.3
8.7000	-0.360	0.3
8.7333	-0.360	0.3
8.7666	-0.351	0.2925
8.8000	-0.360	0.3
8.8333	-0.360	0.3
8.8666	-0.360	0.3
8.9000	-0.360	0.3
8.9333	-0.351	0.2925
8.9666	-0.360	0.3
9.0000	-0.360	0.3
9.0333	-0.360	0.3
9.0666	-0.360	0.3
9.1000	-0.360	0.3
9.1333	-0.360	0.3
9.1666	-0.351	0.2925
9.2000	-0.360	0.3
9.2333	-0.360	0.3
9.2666	-0.360	0.3
9.3000	-0.360	0.3
9.3333	-0.360	0.3
9.3666	-0.351	0.2925
9.4000	-0.351	0.2925
9.4333	-0.351	0.2925
9.4666	-0.360	0.3
9.5000	-0.360	0.3
9.5333	-0.351	0.2925
9.5666	-0.351	0.2925
9.6000	-0.351	0.2925
9.6333	-0.360	0.3
9.6666	-0.351	0.2925
9.7000	-0.360	0.3
9.7333	-0.351	0.2925
9.7666	-0.351	0.2925

9.8000	-0.351	0.2925
9.8333	-0.360	0.3
9.8666	-0.360	0.3
9.9000	-0.360	0.3
9.9333	-0.351	0.2925
9.9666	-0.351	0.2925
10.0000	-0.351	0.2925
10.0333	-0.351	0.2925
10.0667	-0.360	0.3
10.1000	-0.351	0.2925
10.1333	-0.351	0.2925
10.1667	-0.351	0.2925
10.2000	-0.351	0.2925
10.2333	-0.351	0.2925
10.2667	-0.351	0.2925
10.3000	-0.351	0.2925
10.3333	-0.351	0.2925
10.3667	-0.351	0.2925
10.4000	-0.351	0.2925
10.4333	-0.351	0.2925
10.4667	-0.351	0.2925
10.5000	-0.351	0.2925
10.5333	-0.351	0.2925
10.5667	-0.351	0.2925
10.6000	-0.351	0.2925
10.6333	-0.351	0.2925
10.6667	-0.351	0.2925
10.7000	-0.351	0.2925
10.7333	-0.351	0.2925
10.7667	-0.351	0.2925
10.8000	-0.351	0.2925
10.8333	-0.351	0.2925
10.8667	-0.351	0.2925
10.9000	-0.351	0.2925
10.9333	-0.351	0.2925
10.9667	-0.351	0.2925
11.0000	-0.351	0.2925
11.0333	-0.351	0.2925
11.0667	-0.351	0.2925
11.1000	-0.351	0.2925
11.1333	-0.351	0.2925
11.1667	-0.351	0.2925
11.2000	-0.351	0.2925
11.2333	-0.351	0.2925
11.2667	-0.351	0.2925
11.3000	-0.351	0.2925
11.3333	-0.351	0.2925
11.3667	-0.351	0.2925
11.4000	-0.351	0.2925
11.4333	-0.351	0.2925
11.4667	-0.351	0.2925
11.5000	-0.351	0.2925
11.5333	-0.351	0.2925
11.5667	-0.351	0.2925
11.6000	-0.351	0.2925
11.6333	-0.351	0.2925
11.6667	-0.351	0.2925
11.7000	-0.351	0.2925
11.7333	-0.351	0.2925
11.7667	-0.351	0.2925
11.8000	-0.351	0.2925

11.8333	-0.351	0.2925
11.8667	-0.351	0.2925
11.9000	-0.351	0.2925
11.9333	-0.351	0.2925
11.9667	-0.351	0.2925
12.0000	-0.351	0.2925
12.0333	-0.351	0.2925
12.0667	-0.351	0.2925
12.1000	-0.351	0.2925
12.1333	-0.351	0.2925
12.1667	-0.351	0.2925
12.2000	-0.341	0.28416667
12.2333	-0.351	0.2925
12.2667	-0.351	0.2925
12.3000	-0.341	0.28416667
12.3333	-0.351	0.2925
12.3667	-0.351	0.2925
12.4000	-0.351	0.2925
12.4333	-0.351	0.2925
12.4667	-0.351	0.2925
12.5000	-0.351	0.2925
12.5333	-0.341	0.28416667
12.5667	-0.341	0.28416667
12.6000	-0.351	0.2925
12.6333	-0.351	0.2925
12.6667	-0.341	0.28416667
12.7000	-0.341	0.28416667
12.7333	-0.351	0.2925
12.7667	-0.341	0.28416667
12.8000	-0.351	0.2925
12.8333	-0.341	0.28416667
12.8667	-0.351	0.2925
12.9000	-0.351	0.2925
12.9333	-0.341	0.28416667
12.9667	-0.341	0.28416667
13.0000	-0.341	0.28416667
13.0333	-0.351	0.2925
13.0667	-0.341	0.28416667
13.1000	-0.341	0.28416667
13.1333	-0.341	0.28416667
13.1667	-0.341	0.28416667
13.2000	-0.341	0.28416667
13.2333	-0.341	0.28416667
13.2667	-0.341	0.28416667
13.3000	-0.341	0.28416667
13.3333	-0.341	0.28416667
13.3667	-0.341	0.28416667
13.4000	-0.341	0.28416667
13.4333	-0.341	0.28416667
13.4667	-0.341	0.28416667
13.5000	-0.341	0.28416667
13.5333	-0.341	0.28416667
13.5667	-0.341	0.28416667
13.6000	-0.341	0.28416667
13.6333	-0.341	0.28416667
13.6667	-0.341	0.28416667
13.7000	-0.341	0.28416667
13.7333	-0.341	0.28416667
13.7667	-0.341	0.28416667
13.8000	-0.341	0.28416667
13.8333	-0.341	0.28416667

13.8667	-0.341	0.28416667
13.9000	-0.341	0.28416667
13.9333	-0.341	0.28416667
13.9667	-0.341	0.28416667
14.0000	-0.341	0.28416667
14.0333	-0.341	0.28416667
14.0667	-0.341	0.28416667
14.1000	-0.341	0.28416667
14.1333	-0.341	0.28416667
14.1667	-0.341	0.28416667
14.2000	-0.341	0.28416667
14.2333	-0.332	0.27666667
14.2667	-0.332	0.27666667
14.3000	-0.341	0.28416667
14.3333	-0.341	0.28416667
14.3667	-0.341	0.28416667
14.4000	-0.341	0.28416667
14.4333	-0.341	0.28416667
14.4667	-0.332	0.27666667
14.5000	-0.332	0.27666667
14.5333	-0.341	0.28416667
14.5667	-0.332	0.27666667
14.6000	-0.332	0.27666667
14.6333	-0.332	0.27666667
14.6667	-0.332	0.27666667
14.7000	-0.332	0.27666667
14.7333	-0.332	0.27666667
14.7667	-0.332	0.27666667
14.8000	-0.332	0.27666667
14.8333	-0.332	0.27666667
14.8667	-0.332	0.27666667
14.9000	-0.332	0.27666667
14.9333	-0.332	0.27666667
14.9667	-0.332	0.27666667
15.0000	-0.332	0.27666667
15.0333	-0.332	0.27666667
15.0667	-0.332	0.27666667
15.1000	-0.332	0.27666667
15.1333	-0.341	0.28416667
15.1667	-0.332	0.27666667
15.2000	-0.332	0.27666667
15.2333	-0.332	0.27666667
15.2667	-0.332	0.27666667
15.3000	-0.332	0.27666667
15.3333	-0.332	0.27666667
15.3667	-0.332	0.27666667
15.4000	-0.332	0.27666667
15.4333	-0.332	0.27666667
15.4667	-0.332	0.27666667
15.5000	-0.332	0.27666667
15.5333	-0.332	0.27666667
15.5667	-0.332	0.27666667
15.6000	-0.332	0.27666667
15.6333	-0.332	0.27666667
15.6667	-0.332	0.27666667
15.7000	-0.332	0.27666667
15.7333	-0.332	0.27666667
15.7667	-0.332	0.27666667
15.8000	-0.332	0.27666667
15.8333	-0.332	0.27666667
15.8667	-0.322	0.26833333

15.9000	-0.332	0.27666667
15.9333	-0.332	0.27666667
15.9667	-0.332	0.27666667
16.0000	-0.332	0.27666667
16.0333	-0.332	0.27666667
16.0667	-0.332	0.27666667
16.1000	-0.332	0.27666667
16.1333	-0.332	0.27666667
16.1667	-0.332	0.27666667
16.2000	-0.332	0.27666667
16.2333	-0.332	0.27666667
16.2667	-0.332	0.27666667
16.3000	-0.332	0.27666667
16.3333	-0.332	0.27666667
16.3667	-0.332	0.27666667
16.4000	-0.332	0.27666667
16.4333	-0.332	0.27666667
16.4667	-0.332	0.27666667
16.5000	-0.332	0.27666667
16.5333	-0.332	0.27666667
16.5667	-0.332	0.27666667
16.6000	-0.322	0.26833333
16.6333	-0.332	0.27666667
16.6667	-0.332	0.27666667
16.7000	-0.332	0.27666667
16.7333	-0.332	0.27666667
16.7667	-0.332	0.27666667
16.8000	-0.332	0.27666667
16.8333	-0.322	0.26833333
16.8667	-0.322	0.26833333
16.9000	-0.332	0.27666667
16.9333	-0.322	0.26833333
16.9667	-0.332	0.27666667
17.0000	-0.322	0.26833333
17.0333	-0.332	0.27666667
17.0667	-0.332	0.27666667
17.1000	-0.332	0.27666667
17.1333	-0.322	0.26833333
17.1667	-0.322	0.26833333
17.2000	-0.332	0.27666667
17.2333	-0.322	0.26833333
17.2667	-0.322	0.26833333
17.3000	-0.332	0.27666667
17.3333	-0.322	0.26833333
17.3667	-0.322	0.26833333
17.4000	-0.322	0.26833333
17.4333	-0.322	0.26833333
17.4667	-0.322	0.26833333
17.5000	-0.332	0.27666667
17.5333	-0.332	0.27666667
17.5667	-0.322	0.26833333
17.6000	-0.322	0.26833333
17.6333	-0.322	0.26833333
17.6667	-0.322	0.26833333
17.7000	-0.332	0.27666667
17.7333	-0.322	0.26833333
17.7667	-0.332	0.27666667
17.8000	-0.322	0.26833333
17.8333	-0.322	0.26833333
17.8667	-0.322	0.26833333
17.9000	-0.322	0.26833333

17.9333	-0.322	0.26833333
17.9667	-0.322	0.26833333
18.0000	-0.322	0.26833333
18.0333	-0.322	0.26833333
18.0667	-0.322	0.26833333
18.1000	-0.322	0.26833333
18.1333	-0.322	0.26833333
18.1667	-0.322	0.26833333
18.2000	-0.322	0.26833333
18.2333	-0.322	0.26833333
18.2667	-0.322	0.26833333
18.3000	-0.322	0.26833333
18.3333	-0.322	0.26833333
18.3667	-0.322	0.26833333
18.4000	-0.322	0.26833333
18.4333	-0.322	0.26833333
18.4667	-0.322	0.26833333
18.5000	-0.322	0.26833333
18.5333	-0.322	0.26833333
18.5667	-0.322	0.26833333
18.6000	-0.322	0.26833333
18.6333	-0.322	0.26833333
18.6667	-0.322	0.26833333
18.7000	-0.322	0.26833333
18.7333	-0.322	0.26833333
18.7667	-0.322	0.26833333
18.8000	-0.322	0.26833333
18.8333	-0.322	0.26833333
18.8667	-0.322	0.26833333
18.9000	-0.322	0.26833333
18.9333	-0.322	0.26833333
18.9667	-0.322	0.26833333
19.0000	-0.322	0.26833333
19.0333	-0.322	0.26833333
19.0667	-0.322	0.26833333
19.1000	-0.322	0.26833333
19.1333	-0.322	0.26833333
19.1667	-0.322	0.26833333
19.2000	-0.322	0.26833333
19.2333	-0.322	0.26833333
19.2667	-0.322	0.26833333
19.3000	-0.322	0.26833333
19.3333	-0.322	0.26833333
19.3667	-0.322	0.26833333
19.4000	-0.322	0.26833333
19.4333	-0.322	0.26833333
19.4667	-0.322	0.26833333
19.5000	-0.322	0.26833333
19.5333	-0.322	0.26833333
19.5667	-0.322	0.26833333
19.6000	-0.313	0.26083333
19.6333	-0.322	0.26833333
19.6667	-0.313	0.26083333
19.7000	-0.322	0.26833333
19.7333	-0.313	0.26083333
19.7667	-0.313	0.26083333
19.8000	-0.313	0.26083333
19.8333	-0.313	0.26083333
19.8667	-0.313	0.26083333
19.9000	-0.322	0.26833333
19.9333	-0.322	0.26833333

19.9667	-0.313	0.26083333
20.0000	-0.313	0.26083333
20.0333	-0.313	0.26083333
20.0667	-0.313	0.26083333
20.1000	-0.313	0.26083333
20.1333	-0.313	0.26083333
20.1667	-0.313	0.26083333
20.2000	-0.313	0.26083333
20.2333	-0.313	0.26083333
20.2667	-0.313	0.26083333
20.3000	-0.313	0.26083333
20.3333	-0.313	0.26083333
20.3667	-0.313	0.26083333
20.4000	-0.313	0.26083333
20.4333	-0.313	0.26083333
20.4667	-0.313	0.26083333
20.5000	-0.313	0.26083333
20.5333	-0.313	0.26083333
20.5667	-0.313	0.26083333
20.6000	-0.313	0.26083333
20.6333	-0.313	0.26083333
20.6667	-0.313	0.26083333
20.7000	-0.313	0.26083333
20.7333	-0.313	0.26083333
20.7667	-0.313	0.26083333
20.8000	-0.313	0.26083333
20.8333	-0.313	0.26083333
20.8667	-0.313	0.26083333
20.9000	-0.313	0.26083333
20.9333	-0.313	0.26083333
20.9667	-0.313	0.26083333
21.0000	-0.313	0.26083333
21.0333	-0.313	0.26083333
21.0667	-0.313	0.26083333
21.1000	-0.313	0.26083333
21.1333	-0.313	0.26083333
21.1667	-0.313	0.26083333
21.2000	-0.313	0.26083333
21.2333	-0.313	0.26083333
21.2667	-0.313	0.26083333
21.3000	-0.313	0.26083333
21.3333	-0.313	0.26083333
21.3667	-0.313	0.26083333
21.4000	-0.313	0.26083333
21.4333	-0.313	0.26083333
21.4667	-0.313	0.26083333
21.5000	-0.313	0.26083333
21.5333	-0.313	0.26083333
21.5667	-0.313	0.26083333
21.6000	-0.313	0.26083333
21.6333	-0.313	0.26083333
21.6667	-0.313	0.26083333
21.7000	-0.313	0.26083333
21.7333	-0.313	0.26083333
21.7667	-0.313	0.26083333
21.8000	-0.313	0.26083333
21.8333	-0.313	0.26083333
21.8667	-0.313	0.26083333
21.9000	-0.313	0.26083333
21.9333	-0.313	0.26083333
21.9667	-0.313	0.26083333

22.0000	-0.313	0.26083333
22.0333	-0.313	0.26083333
22.0667	-0.313	0.26083333
22.1000	-0.313	0.26083333
22.1333	-0.313	0.26083333
22.1667	-0.313	0.26083333
22.2000	-0.313	0.26083333
22.2333	-0.313	0.26083333
22.2667	-0.313	0.26083333
22.3000	-0.313	0.26083333
22.3333	-0.313	0.26083333
22.3667	-0.313	0.26083333
22.4000	-0.313	0.26083333
22.4333	-0.313	0.26083333
22.4667	-0.313	0.26083333
22.5000	-0.313	0.26083333
22.5333	-0.313	0.26083333
22.5667	-0.313	0.26083333
22.6000	-0.313	0.26083333
22.6333	-0.313	0.26083333
22.6667	-0.313	0.26083333
22.7000	-0.313	0.26083333
22.7333	-0.313	0.26083333
22.7667	-0.313	0.26083333
22.8000	-0.313	0.26083333
22.8333	-0.313	0.26083333
22.8667	-0.313	0.26083333
22.9000	-0.313	0.26083333
22.9333	-0.313	0.26083333
22.9667	-0.313	0.26083333
23.0000	-0.313	0.26083333
23.0333	-0.313	0.26083333
23.0667	-0.313	0.26083333
23.1000	-0.313	0.26083333
23.1333	-0.313	0.26083333
23.1667	-0.313	0.26083333
23.2000	-0.313	0.26083333
23.2333	-0.313	0.26083333
23.2667	-0.313	0.26083333
23.3000	-0.313	0.26083333
23.3333	-0.313	0.26083333
23.3667	-0.313	0.26083333
23.4000	-0.313	0.26083333
23.4333	-0.313	0.26083333
23.4667	-0.313	0.26083333
23.5000	-0.313	0.26083333
23.5333	-0.303	0.2525
23.5667	-0.313	0.26083333
23.6000	-0.303	0.2525
23.6333	-0.313	0.26083333
23.6667	-0.313	0.26083333
23.7000	-0.313	0.26083333
23.7333	-0.303	0.2525
23.7667	-0.313	0.26083333
23.8000	-0.313	0.26083333
23.8333	-0.313	0.26083333
23.8667	-0.313	0.26083333
23.9000	-0.313	0.26083333
23.9333	-0.313	0.26083333
23.9667	-0.303	0.2525
24.0000	-0.303	0.2525

24.0333	-0.313	0.26083333
24.0667	-0.303	0.2525
24.1000	-0.303	0.2525
24.1333	-0.313	0.26083333
24.1667	-0.313	0.26083333
24.2000	-0.313	0.26083333
24.2333	-0.303	0.2525
24.2667	-0.303	0.2525
24.3000	-0.303	0.2525
24.3333	-0.303	0.2525
24.3667	-0.313	0.26083333
24.4000	-0.303	0.2525
24.4333	-0.303	0.2525
24.4667	-0.303	0.2525
24.5000	-0.303	0.2525
24.5333	-0.303	0.2525
24.5667	-0.303	0.2525
24.6000	-0.303	0.2525
24.6333	-0.313	0.26083333
24.6667	-0.303	0.2525
24.7000	-0.303	0.2525
24.7333	-0.303	0.2525
24.7667	-0.303	0.2525
24.8000	-0.303	0.2525
24.8333	-0.303	0.2525
24.8667	-0.303	0.2525
24.9000	-0.303	0.2525
24.9333	-0.303	0.2525
24.9667	-0.303	0.2525
25.0000	-0.303	0.2525
25.0333	-0.303	0.2525
25.0667	-0.303	0.2525
25.1000	-0.303	0.2525
25.1333	-0.303	0.2525
25.1667	-0.303	0.2525
25.2000	-0.303	0.2525
25.2333	-0.303	0.2525
25.2667	-0.303	0.2525
25.3000	-0.303	0.2525
25.3333	-0.303	0.2525
25.3667	-0.303	0.2525
25.4000	-0.303	0.2525
25.4333	-0.303	0.2525
25.4667	-0.303	0.2525
25.5000	-0.303	0.2525
25.5333	-0.303	0.2525
25.5667	-0.303	0.2525
25.6000	-0.303	0.2525
25.6333	-0.303	0.2525
25.6667	-0.303	0.2525
25.7000	-0.303	0.2525
25.7333	-0.303	0.2525
25.7667	-0.303	0.2525
25.8000	-0.303	0.2525
25.8333	-0.303	0.2525
25.8667	-0.303	0.2525
25.9000	-0.303	0.2525
25.9333	-0.303	0.2525
25.9667	-0.303	0.2525
26.0000	-0.303	0.2525
26.0333	-0.303	0.2525

26.0667	-0.303	0.2525
26.1000	-0.303	0.2525
26.1333	-0.303	0.2525
26.1667	-0.303	0.2525
26.2000	-0.303	0.2525
26.2333	-0.303	0.2525
26.2667	-0.303	0.2525
26.3000	-0.303	0.2525
26.3333	-0.303	0.2525
26.3667	-0.303	0.2525
26.4000	-0.303	0.2525
26.4333	-0.303	0.2525
26.4667	-0.303	0.2525
26.5000	-0.303	0.2525
26.5333	-0.303	0.2525
26.5667	-0.303	0.2525
26.6000	-0.303	0.2525
26.6333	-0.303	0.2525
26.6667	-0.303	0.2525
26.7000	-0.303	0.2525
26.7333	-0.303	0.2525
26.7667	-0.303	0.2525
26.8000	-0.303	0.2525
26.8333	-0.303	0.2525
26.8667	-0.303	0.2525
26.9000	-0.303	0.2525
26.9333	-0.303	0.2525
26.9667	-0.303	0.2525
27.0000	-0.303	0.2525
27.0333	-0.303	0.2525
27.0667	-0.303	0.2525
27.1000	-0.303	0.2525
27.1333	-0.303	0.2525
27.1667	-0.303	0.2525
27.2000	-0.303	0.2525
27.2333	-0.303	0.2525
27.2667	-0.303	0.2525
27.3000	-0.303	0.2525
27.3333	-0.303	0.2525
27.3667	-0.303	0.2525
27.4000	-0.303	0.2525
27.4333	-0.303	0.2525
27.4667	-0.303	0.2525
27.5000	-0.303	0.2525
27.5333	-0.303	0.2525
27.5667	-0.303	0.2525
27.6000	-0.303	0.2525
27.6333	-0.303	0.2525
27.6667	-0.303	0.2525
27.7000	-0.303	0.2525
27.7333	-0.303	0.2525
27.7667	-0.303	0.2525
27.8000	-0.303	0.2525
27.8333	-0.303	0.2525
27.8667	-0.303	0.2525
27.9000	-0.303	0.2525
27.9333	-0.303	0.2525
27.9667	-0.303	0.2525
28.0000	-0.303	0.2525
28.0333	-0.303	0.2525
28.0667	-0.303	0.2525

28.1000	-0.303	0.2525
28.1333	-0.303	0.2525
28.1667	-0.303	0.2525
28.2000	-0.303	0.2525
28.2333	-0.303	0.2525
28.2667	-0.303	0.2525
28.3000	-0.303	0.2525
28.3333	-0.303	0.2525
28.3667	-0.303	0.2525
28.4000	-0.303	0.2525
28.4333	-0.303	0.2525
28.4667	-0.303	0.2525
28.5000	-0.303	0.2525
28.5333	-0.303	0.2525
28.5667	-0.303	0.2525
28.6000	-0.303	0.2525
28.6333	-0.303	0.2525
28.6667	-0.303	0.2525
28.7000	-0.303	0.2525
28.7333	-0.303	0.2525
28.7667	-0.303	0.2525
28.8000	-0.303	0.2525
28.8333	-0.303	0.2525
28.8667	-0.303	0.2525
28.9000	-0.303	0.2525
28.9333	-0.303	0.2525
28.9667	-0.294	0.245
29.0000	-0.303	0.2525
29.0333	-0.303	0.2525
29.0667	-0.303	0.2525
29.1000	-0.303	0.2525
29.1333	-0.294	0.245
29.1667	-0.294	0.245
29.2000	-0.294	0.245
29.2333	-0.303	0.2525
29.2667	-0.303	0.2525
29.3000	-0.303	0.2525
29.3333	-0.294	0.245
29.3667	-0.294	0.245
29.4000	-0.294	0.245
29.4333	-0.303	0.2525
29.4667	-0.294	0.245
29.5000	-0.294	0.245
29.5333	-0.303	0.2525
29.5667	-0.294	0.245
29.6000	-0.294	0.245
29.6333	-0.294	0.245
29.6667	-0.294	0.245
29.7000	-0.294	0.245
29.7333	-0.294	0.245
29.7667	-0.294	0.245
29.8000	-0.294	0.245
29.8333	-0.294	0.245
29.8667	-0.294	0.245
29.9000	-0.294	0.245
29.9333	-0.294	0.245
29.9667	-0.294	0.245
30.0000	-0.294	0.245
30.0333	-0.294	0.245
30.0667	-0.294	0.245
30.1000	-0.294	0.245

30.1333	-0.294	0.245
30.1667	-0.294	0.245
30.2000	-0.294	0.245
30.2333	-0.294	0.245
30.2667	-0.294	0.245
30.3000	-0.294	0.245
30.3333	-0.294	0.245
30.3667	-0.294	0.245
30.4000	-0.294	0.245
30.4333	-0.294	0.245
30.4667	-0.294	0.245
30.5000	-0.294	0.245
30.5333	-0.294	0.245
30.5667	-0.294	0.245
30.6000	-0.294	0.245
30.6333	-0.294	0.245
30.6667	-0.294	0.245
30.7000	-0.294	0.245
30.7333	-0.294	0.245
30.7667	-0.294	0.245
30.8000	-0.294	0.245
30.8333	-0.294	0.245
30.8667	-0.294	0.245
30.9000	-0.294	0.245
30.9333	-0.294	0.245
30.9667	-0.294	0.245
31.0000	-0.294	0.245
31.0333	-0.294	0.245
31.0667	-0.294	0.245
31.1000	-0.294	0.245
31.1333	-0.294	0.245
31.1667	-0.294	0.245
31.2000	-0.294	0.245
31.2333	-0.294	0.245
31.2667	-0.294	0.245
31.3000	-0.294	0.245
31.3333	-0.294	0.245
31.3667	-0.294	0.245
31.4000	-0.294	0.245
31.4333	-0.294	0.245
31.4667	-0.294	0.245
31.5000	-0.294	0.245
31.5333	-0.294	0.245

To = 117

K = 1.65E-06 ft/min
8.40E-07 cm/sec

APPENDIX B

PIT INFLOW CALCULATIONS

PIT FLOW CALCULATIONS

The Jacob-Lohman formula is shown below:

$$Q = \frac{4 \pi T \Delta h}{\ln \left(\frac{2.25 T t}{r_w^2 S}\right)}$$

where:

- Q = Inflow in feet^3/day
- T = Transmissivity in feet^2/day
- Δh = Drawdown in feet
- t = Time in days
- r_w = Radius of the pit/inflow area in feet
- S = Storativity

For the purposes of this groundwater inflow estimate WESTEC used the following:

EAST PIT

- T = 1.0 feet^2/day
- Δh = 200 feet
- t = 100 days
- r_w = 800 feet
- S = 0.02

WEST PIT

- T = 0.5 feet^2/day
- Δh = 110 feet
- t = 100 days
- r_w = 600 feet
- S = 0.02

This calculation was used to determine a groundwater inflow estimate for the East Pit. The transmissivity and storage values were selected from the slug test data analysis; the drawdown value selected is the static groundwater elevation minus projected total pit depth. The r_w factor, a radius of 800 feet, and 600 feet was selected by measuring the diameter of the pit at the projected static water level. The time factor of 100 days was selected to avoid factoring in the increased flow effects due to draining the bedrock aquifer to the base of the pit. The estimated a groundwater inflow contributed from the bedrock aquifer into the East and West pits after 100 days was calculated to be 300 feet^3/day (1.5 gpm) and 150 ft^3/day (0.7 gpm), respectively.

This page intentionally left blank
for reproduction purposes.

APPENDIX C

WELL INSTALLATIONS

WELL INSTALLATIONS

Three types of wells have been installed at the project: a monitoring well, a water level piezometer, and a water supply test well. Installation of each type is described below.

MONITORING WELL

A monitoring well (MW-1) was drilled and installed by Harris Drilling Company and CHEMGOLD personnel using an air/mud rotary drilling rig. The monitoring well was installed upgradient of the proposed mine pit area, and is shown in Figure 4.3 in the body of the report.

A diagram of the monitoring well design is included in the text as Figure 5.1. Monitoring well MW-1 was installed to a depth of 640 feet and was constructed with 1½-inch-diameter schedule 80 PVC pipe, with 60 feet of 0.04 slot schedule 80 PVC screen in the water table.

The PVC casing was placed in the hole and then backfilled with washed 1/4-inch gravel to a depth of about 400 feet. A bentonite plug was placed over the gravel and a mixture of drill cuttings and gravel was placed above the plug to within approximately 20 feet of the surface. Approximately 20 feet of bentonite grout was placed into the annular space. The upper 10 feet of well casing is 1½-inch steel casing extending approximately 2 feet above the surface. The surface construction features consist of a 4-inch-diameter piece of steel surface casing with a locking cap. The geologic log for the monitoring well is included in Appendix D.

PIEZOMETER WELLS

Eight piezometers were installed in and around the proposed mine project area to evaluate static groundwater elevations, to determine geologic formations, and to estimate in-situ aquifer hydraulic properties. The locations of the eight piezometers are shown in Figure 4.3 in the report. Each of the piezometers was installed in a reverse circulation exploration borehole. The boreholes were drilled with a 5¾-inch-diameter hammer bit to the total depth. The holes were backfilled to the desired screen depth with cuttings. After backfilling, 1½-inch schedule 80 PVC pipe with 20 feet of perforated casing was installed at the desired depth, and 25 to 80 feet of cuttings was placed around the perforated casing. The gravel pack was capped with approximately 5 feet of coarse bentonite. Well data for the piezometers installed in the alluvial and bedrock aquifers is summarized in Table 4.2 and 4.4. Geologic logs for the piezometer wells are included in Appendix D.

WATER SUPPLY TEST WELL

A production test well, PW-1, was installed at the Imperial Project site to test aquifer hydrologic parameters and to evaluate the groundwater supply to meet anticipated project water requirements. Well PW-1 is in the SW 1/4, SE ½, Section 15, Township 14 South, Range 20 East San Bernardino Baseline and Meridian and is shown in Figure 4-3 of the report.

PW-1 was drilled using a mud rotary drilling system equipped with a tricone bit. Forty feet of 18-inch conductor casing was installed and a 17½-inch borehole was drilled from 40 feet to a total depth of 960 feet. The well was constructed of 12-inch schedule 40 low carbon steel, with 200 feet of 0.090 mill slot well screen placed at the base of the well. A 5-foot cement plug was placed at the base of the well screen in the event that CHEMGOLD

decides to deepen the well in the future. While the well was being installed, 42 feet of cave material filled the base of the hole. Consequently, the well screen extended from 918 feet below ground surface (bgs) to 718 feet bgs. The filter pack/sand pack material was a mixture of sieve size No. 4 to No. 6 pea gravel and extended from the base of the well, 918 feet bgs, to 145 feet bgs. A 3-foot seal consisting of hydrated coarse bentonite hole plug was installed above the sand pack. A neat cement and bentonite grout mixture was placed into the annular space from 142 feet bgs to the surface. A well cap was welded to the top of the casing to prevent tampering with the test well. These construction features conform with California well standards. A construction diagram for well PW-1 is shown in Figure 5-2 of the report.

The well was developed by airlifting for approximately eight hours. The well was also surged with a turbine pump which had been temporarily installed for the aquifer testing. The well was developed until discharge groundwater was clear and free of turbidity, and until water quality parameters (pH, specific conductance, and temperature) were stabilized. A water quality sample (PW-1, Table 6.2) was collected during the aquifer test. A geologic and well construction log is included in Appendix D.

APPENDIX D

GEOLOGIC LOGS FOR PIEZOMETER, MONITORING WELL, AND PRODUCTION WELL

The information otherwise contained in this
Appendix/Attachment has been deleted from the
Draft Environmental Impact Statement/Environmental Impact Report (DEIS/EIR).

This deleted information can be found in its entirety at the
Bureau of Land Management
El Centro Resource Area Office

APPENDIX E

PUMP TEST FIELD DATA AND CALCULATIONS

PUMPING TEST DATA ANALYSIS

Aquifer transmissivity and storativity parameters were determined from the analysis of the test production well, PW-1, pumping and recovery test data. Two methods were used to calculate aquifer transmissivity and storativity values from the time-drawdown and time-recovery data. Both approaches are graphical. The first involves curve matching on a log-log plot (the Theis method), and the second involves interpretations with a semilog plot (the Jacob method).

Theis Type-Curve Matching

The time-drawdown data recorded in the observational piezometer, H-4, was analyzed by the following curve matching procedure:

1. Measured time-drawdown values were plotted as drawdown versus time on log-log paper of the same size and scale as the *W(u)* versus 1/*u* curve.

2. The field data curve was superimposed on the Theis type curves keeping the coordinate axes parallel. The curves were adjusted until most of the observed data points fell on a Theis type curve (Figure 1).

3. The match point of the two curves was made at *W(u)* = 1.0 and *u* = 1.0. The corresponding values of drawdown (s) and time (t) at the match point were read from the field data curve.

4. Using these values, together with the pumping rate and the radial distance from the pumping well to the piezometer, transmissivity was determined from the equation

$$T = \frac{QW(u)}{4\pi s}$$

where T = transmissivity (gpd/ft)
Q = flow rate (gpm)
s = drawdown (feet)

5. Storativity was calculated using the formula

$$S = \frac{4uTt}{r^2}$$

where S = storativity
T = transmissivity (gpd/ft)
t = time (day)
r = radial distance from well (feet)

6. Permeabilities were detemined from the relationship:

K = T/b (T = Kb)
K = permeability (gpd/ft^2)
T = transmissivity (gpd/ft)
b = formation saturation thickness (feet)

7. The hydraulic parameters calculated, from the drawdown data measured in the observational piezometer, H-4, by the Theis type curve matching technique are summarized below. The following parameters were used in the above equations:

Q = 500 gpm
s = 4.65 feet (determined from Figure 1)
t = 50 minutes (determined from Figure 1)
r = 91 feet
b = 200 feet

TRANSMISSIVITY	STORATIVITY	PERMEABILITY (HYDRAULIC CONDUCTIVITY)
12,322 gpd/ft	0.03	62 gpd/ft^2
1,645 ft^2/day		8 ft/day

Cooper-Jacob Straight Line Approximation Method

Aquifer parameters were determined from the pump test and recovery test data using the Cooper-Jacob straight line approximation method as described below:

1. The drawdown and recovery data measured in the pumping well, PW-1, and observation well, H-4, were plotted versus log time.

2. The slope of the straight line segments of the graphs were determined over one log cycle to calculate the drawdown per log cycle.

3. The straight line drawn through the field-data points was extended backward to the zero drawdown axis to determine t_0.

4. Transmissivity was determined using the formula

$$T = \frac{2.3Q}{4\pi s}$$

where T = transmissivity (gpd/ft)
Q = flow rate (gpm)
s = slope of straight line segments over one log cycle on drawdown/recovery versus log time graphs

5. Storativity was calculated from the following formula

$$S = \frac{2.25\ T\ t_0}{r^2}$$

where S = storativity
T = transmissivity (gpd/ft)
t_0 = time (day)
r = radial distance from well (feet)

6. Permeabilities were determined from the relation:

$K = T/b \quad (T = Kb)$
K = permeability (gpd/ft^2)
T = transmissivity (gpd/ft)
b = formation saturation thickness (feet)

7. The calculated hydraulic parameters are summarized as follows:

PUMP TEST			
CURVE	TRANSMISSIVITY	STORATIVITY	PERMEABILITY (HYDRAULIC CONDUCTIVITY
H-4 initial segment	20,160 gpd/ft	0.02	101 gpd/ft^2
	2,701 ft^2/day		14 ft/day
H-4 latter segment	40,320 gpd/ft	0.003	202 gpd/ft^2
	5,403 ft^2/day		27 ft/day
PW-1 initial segment	7,200 gpd/ft		36 gpd/ft^2
	965 ft^2/day		5 ft/day
PW-1 latter segment	37,440 gpd/ft		187 gpd/ft^2
	5017 ft^2/day		25 ft/day

RECOVERY TEST			
CURVE	TRANSMISSIVITY	STORATIVITY	PERMEABILITY (HYDRAULIC CONDUCTIVITY
H-4 initial segment	42,508 gpd/ft		213 gpd/ft^2
	5,696 ft^2/day		28 ft/day
H-4 middle segment	20,000 gpd/ft	0.001	100 gpd/ft^2
	2,680 ft^2/day		13 ftday
H-4 latter segment	21,600 gpd/ft	0.001	109 gpd/ft^2
	2,919 ft^2/day		15 ft/day
PW-1 initial segment	12,960 gpd/ft		65 gpd/ft^2
	1,737 ft^2/day		9 ft/day
PW-1 latter segment	33,120 gpd/ft		166 gpd/ft^2
	4,438 ft^2/day		22 ft/day

8. The Cooper-Jacob method can be used for evaluating pump and recovery test data if the following assumptions and conditions are satisfied (Kruseman and de Ridder):

- The aquifer is confined;
- The aquifer has a seemingly infinite areal extent;
- The aquifer is homogeneous, isotropic, and of uniform thickness over the area influenced by the test;
- Prior to pumping, the piezometric surface is horizontal (or nearly so) over the area that will be influenced by the test;
- The aquifer is pumped at a constant discharge rate;
- The well penetrates the entire thickness of the aquifer and thus receives water by horizontal flow;
- The flow to the well is in unsteady state; and
- The values of u are small ($u<0.1$), i.e. r is small and t is sufficiently large.

When the values of T and S were determined, they were substituted into the equation below to check whether $u < 0.1$, which is a practical condition for the applicability of the Cooper-Jacob method (Kruseman and de Ridder).

$$u = \frac{r^2 S}{T t}$$

where
- $r =$ radial distance from the well (feet)
- $S =$ storativity
- $T =$ transmissivity (ft^2/day)
- $t =$ time (day)

Example: The pump test data from well H-4 (Figure 2) is used to illustrate this check. For the initial curve segment: Substitution of the values $T = 2701$ ft^2/day; $S = 0.02$; and $r = 91$ feet into the above equation shows that, for $t >$ 216 minutes, $u < 0.1$, as is required.

For the latter curve segment: $t > 11$ minutes for $u < 0.1$, when the values of $T = 5403$ ft^2/day; $S = 0.003$; and $r = 91$ feet are substituted into the above equation.

This analysis showed that both straight line segments of the H-4 drawdown versus log time graph may be used for evaluation of formation hydraulic parameters since the drawdown values which fell along the initial segment of the drawdown curve were measured at values of $t > 216$ minutes and the drawdown values which fell along the latter segment of the curve were measured at values of $t > 11$ minutes. A similar analysis was performed for the recovery test data measured in well H-4 (Figure 3) to verify that the condition, $u < 0.1$ was satisfied for the results presented in the above table. The analysis indicated that this condition was satisfied for the recovery test data.

9. The aquifer transmissivity can be estimated from single-well test data when the following time condition is met.

$$t > \frac{25\, r_c^2}{T}$$

where
- t = elapsed time of test (minutes)
- r_c = radius of well casing (feet)
- T = transmissivity (ft^2/day)

If this time condition is met, the effect of well-bore storage can be neglected.

Example: The pump test data from PW-1 (Figure 4) is used as an illustration. For the initial curve segment data, well bore storage may be neglected at times greater than 10 minutes for T = 965 ft^2/day and r_c = 0.5 feet. The effects of well bore storage are neglible at t > 2 minutes for the latter drawdown data when T = 5,017 ft^2/day and r_c = 0.5 feet.

A similar check was made on the measurements made in PW-1 during the recovery test (Figure 5). The analysis showed that the measurements were made at time where the effect of well bore storage could be neglected.

Selected Type Curves of Dimensionless Drawdown (W(u,r/B)) vs. Dimensionless Time (1/u) for Constant Discharge from a Fully Penetrating Well in a Leaky Confined Aquifer with No Storage in the Confining Layer (after Hantush and Jacob, 1955)

Figure 1

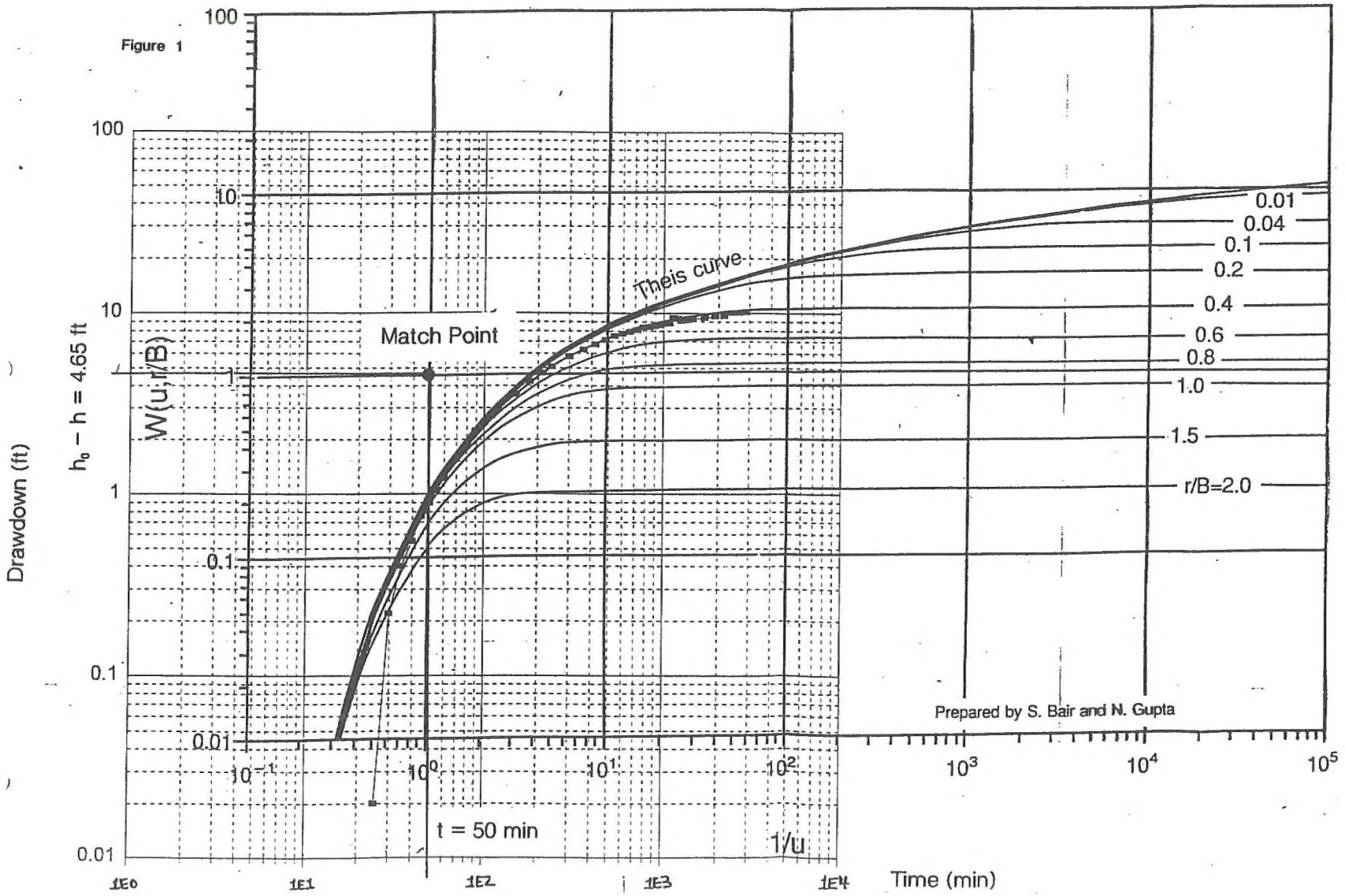
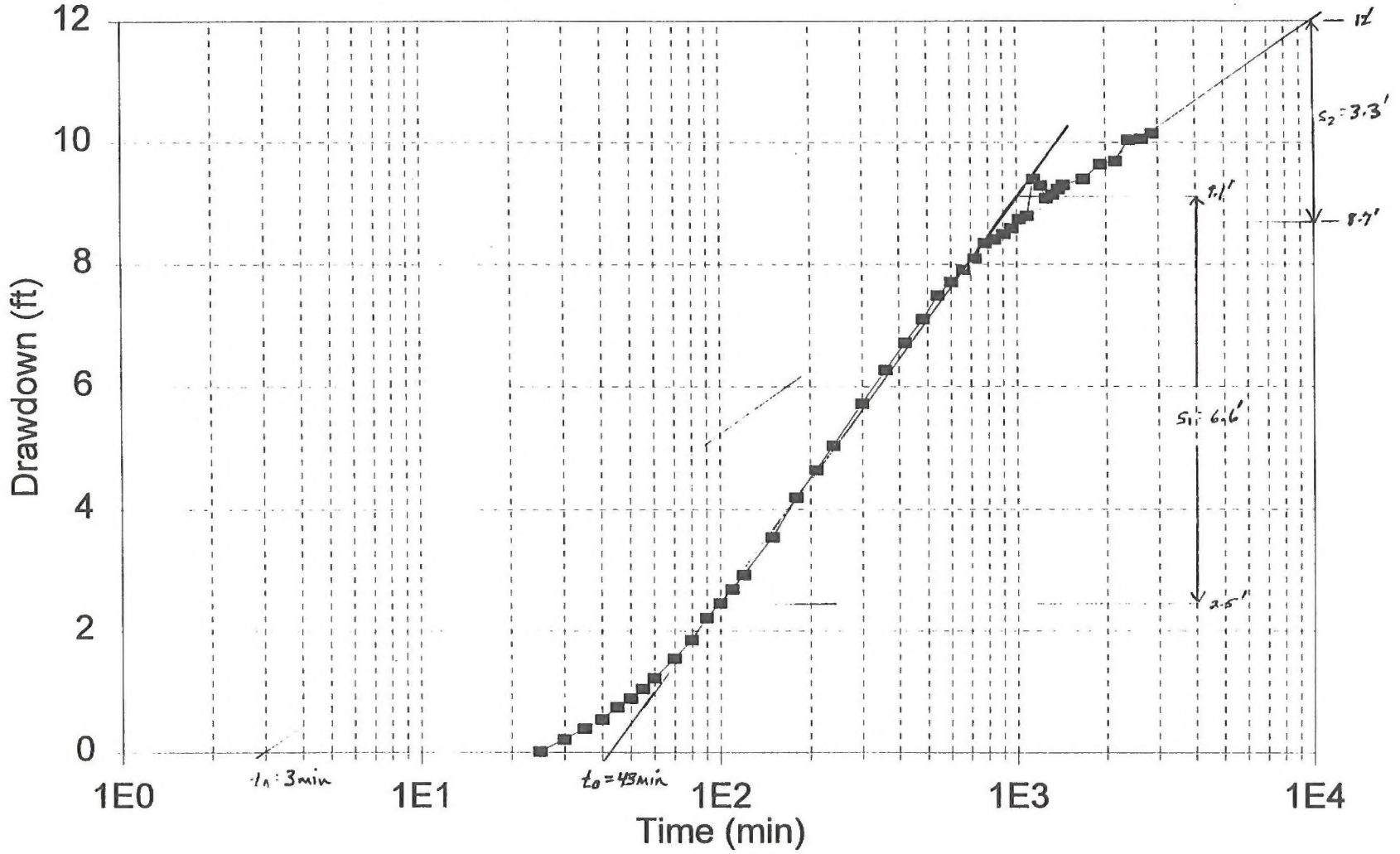


Figure 2

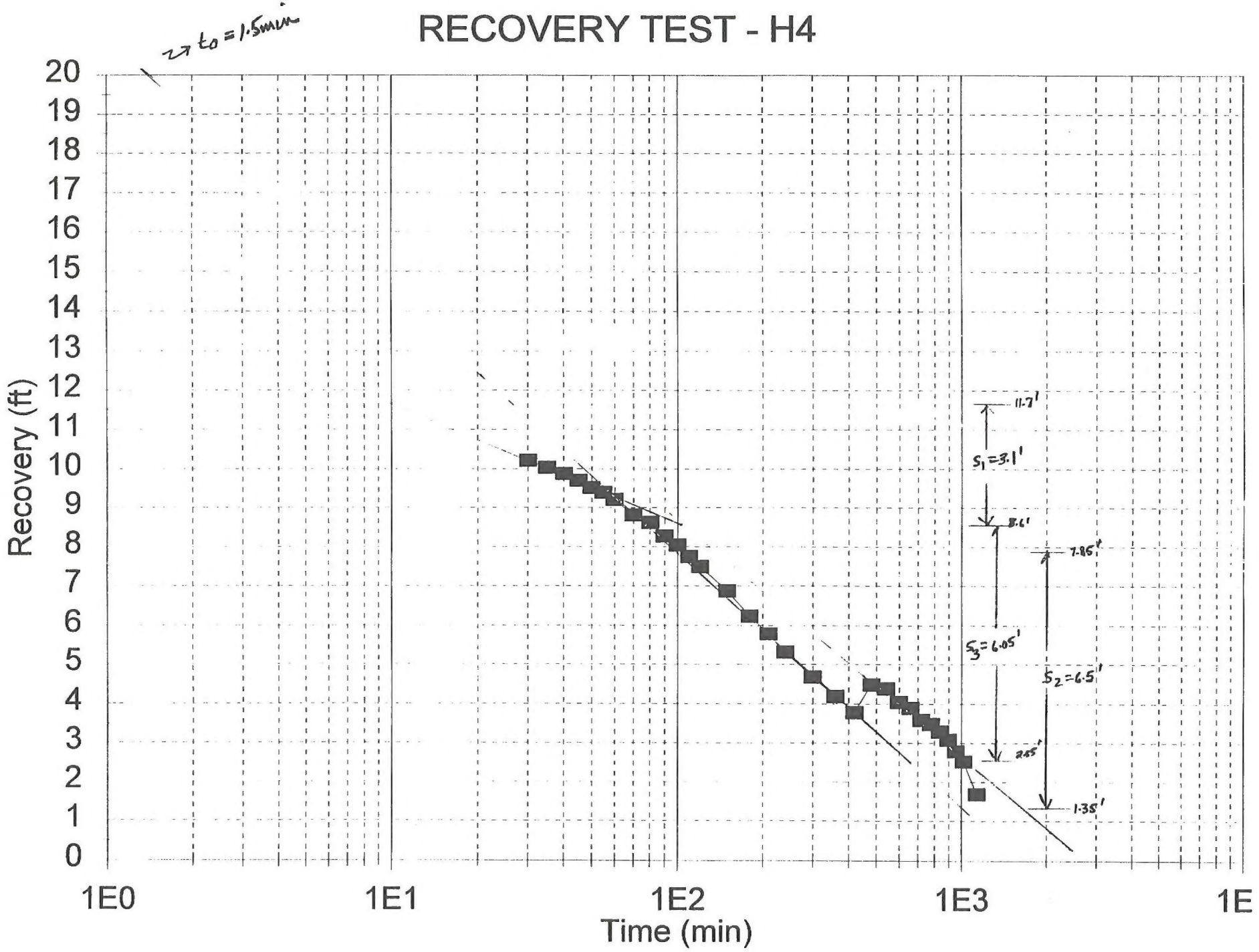
PUMP TEST - H4



PUMP TEST - H-4 (OBSERVATION WELL)

Time After Pumping Started (min)	DTW (ft)	Drwdwn (ft)
0	544.4	
25	544.42	0.02
30	544.62	0.22
35	544.8	0.4
40	544.95	0.55
45	545.15	0.75
50	545.29	0.89
55	545.45	1.05
60	545.62	1.22
70	545.95	1.55
80	546.25	1.85
90	546.62	2.22
100	546.87	2.47
110	547.09	2.69
120	547.33	2.93
150	547.95	3.55
180	548.6	4.2
210	549.05	4.65
240	549.45	5.05
300	550.13	5.73
360	550.68	6.28
420	551.12	6.72
480	551.51	7.11
540	551.89	7.49
600	552.11	7.71
660	552.31	7.91
720	552.5	8.1
780	552.75	8.35
840	552.81	8.41
900	552.9	8.5
960	553	8.6
1020	553.15	8.75
1080	553.2	8.8
1140	553.8	9.4
1200	553.7	9.3
1260	553.49	9.09
1320	553.55	9.15
1380	553.64	9.24
1440	553.71	9.31
1680	553.8	9.4
1920	554.05	9.65
2160	554.1	9.7
2400	554.45	10.05
2640	554.47	10.07
2880	554.56	10.16

Figure 3

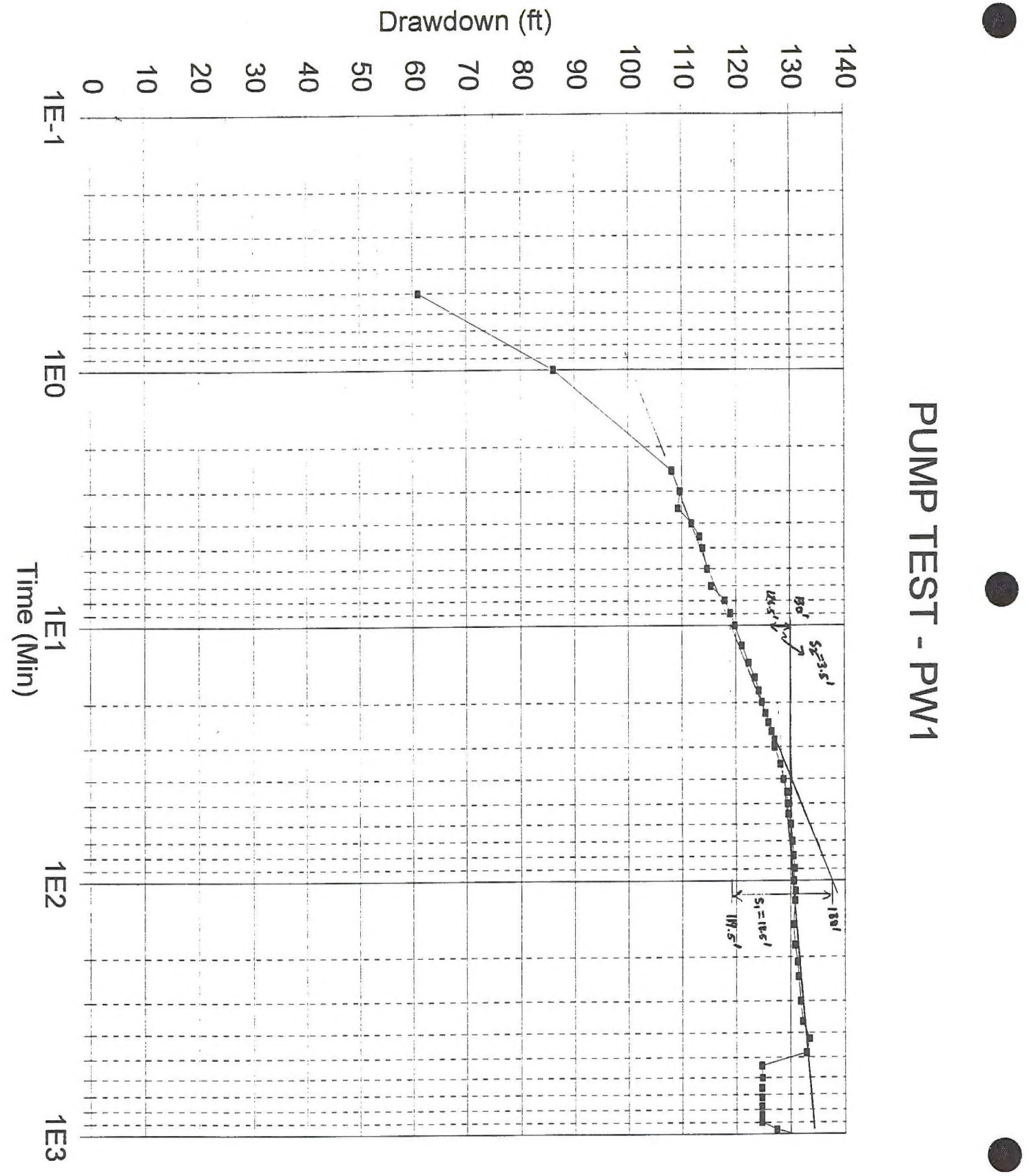

RECOVERY TEST - H4
to = 1.5min
Recovery (ft)
Time (min)
20
19
18
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
1E0
1E1
1E2
1E3
1E
11.7'
S1=3.1'
8.6'
7.85'
S3=6.05'
S2=6.5'
2.45'
1.35'

RECOVERY TEST - H-4 (OBSERVATION WELL)

Static Wtr Level (start pump test) in ft = 544.4

Recovery Test Time (min) t'	DTW (ft)	Recovery (ft)	Recovery meas. between readings (ft)	Time After Pumping Stopped (min) t	
0	554.64	10.24	0	t(o) = 2970	t/t'
30	554.62	10.22	0.02	3000	100.0
35	554.44	10.04	0.2	3005	85.9
40	554.28	9.88	0.36	3010	75.3
45	554.11	9.71	0.53	3015	67.0
50	553.92	9.52	0.72	3020	60.4
55	553.8	9.4	0.84	3025	55.0
60	553.61	9.21	1.03	3030	50.5
70	553.22	8.82	1.42	3040	43.4
80	553.03	8.63	1.61	3050	38.1
90	552.68	8.28	1.96	3060	34.0
100	552.45	8.05	2.19	3070	30.7
110	552.16	7.76	2.48	3080	28.0
120	551.9	7.5	2.74	3090	25.8
150	551.28	6.88	3.36	3120	20.8
180	550.65	6.25	3.99	3150	17.5
210	550.2	5.8	4.44	3180	15.1
240	549.73	5.33	4.91	3210	13.4
300	549.09	4.69	5.55	3270	10.9
360	548.6	4.2	6.04	3330	9.3
420	548.2	3.8	6.44	3390	8.1
480	548.9	4.5	5.74	3450	7.2
540	548.8	4.4	5.84	3510	6.5
600	548.45	4.05	6.19	3570	6.0
660	548.3	3.9	6.34	3630	5.5
720	548	3.6	6.64	3690	5.1
780	547.9	3.5	6.74	3750	4.8
840	547.7	3.3	6.94	3810	4.5
900	547.5	3.1	7.14	3870	4.3
960	547.2	2.8	7.44	3930	4.1
1020	546.95	2.55	7.69	3990	3.9
1140	546.1	1.7	8.54	4110	3.6

Figure 4

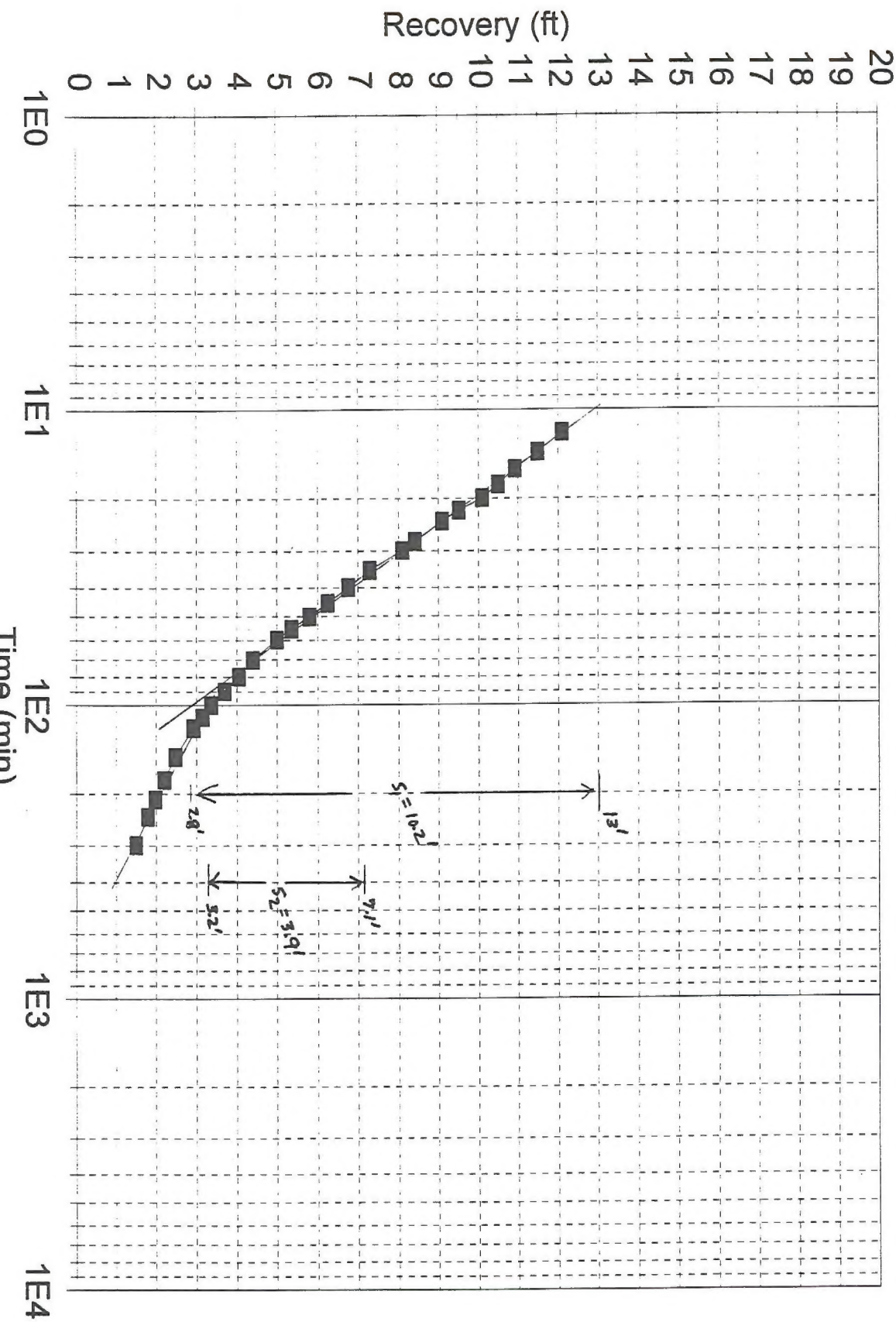

PUMP TEST - PW1
Drawdown (ft)
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
1E-1
1E0
1E1
1E2
1E3
Time (Min)

PUMP TEST - P-1 (PUMPING WELL)

Time After Pumping Started (min)	DTW (ft)	Drwdwn (ft)
0	543.9	
0.5	605	61.1
1	630	86.1
2.5	652	108.1
3	653.5	109.6
3.5	653.14	109.24
4	655.7	111.8
4.5	657.2	113.3
5	657.8	113.9
6	658.64	114.74
7	659.24	115.34
8	661.9	118
9	662.94	119.04
10	663.8	119.9
12	665.14	121.24
14	666.3	122.4
16	667.44	123.54
18	668.26	124.36
20	668.78	124.88
22	669.46	125.56
24	670.04	126.14
26	670.58	126.68
28	671.12	127.22
30	671.16	127.26
35	672.18	128.28
40	672.72	128.82
45	673.44	129.54
50	673.54	129.64
55	673.62	129.72
60	674.06	130.16
70	674.32	130.42
80	674.56	130.66
90	674.72	130.82
100	674.64	130.74
110	674.9	131
120	674.84	130.94
150	674.5	130.6
180	674.84	130.94
210	675.27	131.37
240	675.48	131.58
300	675.88	131.98
360	676.24	132.34
420	677.44	133.54
480	676.84	132.94
540	668.73	124.83
600	668.77	124.87
660	668.73	124.83

Time After Pumping Started (min)	DTW (ft)	Drwdwn (ft)
720	668.72	124.82
780	668.74	124.84
840	668.72	124.82
900	668.71	124.81
960	671.42	127.52
1020	676.1	132.2
1080	676.31	132.41
1140	676.42	132.52
1200	676.3	132.4
1260	675.84	131.94
1320	675.32	131.42
1380	674.44	130.54
1440	674.92	131.02
1680	674.9	131
1920	674.7	130.8
2160	674.9	131
2400	675.1	131.2
2640	674.3	130.4
2880	674.31	130.41

Figure 5


RECOVERY TEST - PW1
Recovery (ft)
Time (min)
1E0
1E1
1E2
1E3
1E4
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
13'
S1 = 10.2'
7.1'
S2 = 3.9'
5.2'
2.8'

RECOVERY TEST - PW-1 (PUMPING WELL)

Static Wtr Level (start pump test) in ft = 543.9

Recovery Test Time (min) t'	DTW (ft)	Recovery (ft)	Recovery Meas. Between Read (ft)	Time After Pumping Stopped (min) t	
0	674	130.1	0	t(o) = 2970	t/t'
12	556	12.1	118	2982	248.5
14	555.4	11.5	118.6	2984	213.1
16	554.82	10.92	119.18	2986	186.6
18	554.4	10.5	119.6	2988	166.0
20	554	10.1	120	2990	149.5
22	553.42	9.52	120.58	2992	136.0
24	553	9.1	121	2994	124.8
28	552.32	8.42	121.68	2998	107.1
30	552	8.1	122	3000	100.0
35	551.2	7.3	122.8	3005	85.9
40	550.66	6.76	123.34	3010	75.3
45	550.15	6.25	123.85	3015	67.0
50	549.71	5.81	124.29	3020	60.4
55	549.26	5.36	124.74	3025	55.0
60	548.9	5	125.1	3030	50.5
70	548.3	4.4	125.7	3040	43.4
80	547.96	4.06	126.04	3050	38.1
90	547.6	3.7	126.4	3060	34.0
100	547.26	3.36	126.74	3070	30.7
110	547.05	3.15	126.95	3080	28.0
120	546.82	2.92	127.18	3090	25.8
150	546.38	2.48	127.62	3120	20.8
180	546.1	2.2	127.9	3150	17.5
210	545.88	1.98	128.12	3180	15.1
240	545.7	1.8	128.3	3210	13.4
300	545.4	1.5	128.6	3270	10.9

This page intentionally left blank
for reproduction purposes.

APPENDIX F

WATER QUALITY ANALYSES

The information otherwise contained in this
Appendix/Attachment has been deleted from the
Draft Environmental Impact Statement/Environmental Impact Report (DEIS/EIR).

This deleted information can be found in its entirety at the
Bureau of Land Management
El Centro Resource Area Office

APPENDIX E-2 - SUPPLEMENT TO HYDROLOGY BASELINE REPORT FOR THE IMPERIAL PROJECT, IMPERIAL COUNTY, CALIFORNIA

CHEMGOLD, INC. IMPERIAL PROJECT
IMPERIAL COUNTY, CALIFORNIA

SUPPLEMENTAL HYDROLOGY STUDY FOR THE IMPERIAL PROJECT
IMPERIAL COUNTY, CALIFORNIA

EMA Report No. 1093-01
September 1996

Prepared for:

Chemgold, Inc.
P.O. Box 758
Winterhaven, California 92283

CHEMGOLD, INC. IMPERIAL PROJECT
IMPERIAL COUNTY, CALIFORNIA

SUPPLEMENTAL HYDROLOGY STUDY

EMA Report No. 1093-01
September 1996

Prepared for:

Chemgold, Inc.
P.O. Box 758
Winterhaven, California 92283

LIMITATIONS

This report was prepared by Environmental Management Associates, Inc. (EMA) in conformance with the scope of work prescribed by our CLIENT. The work has been conducted in an objective and unbiased manner and in accord with generally accepted professional practice for this type of work. No other warranty, either expressed or implied, is made as to the findings, recommendations, specifications or opinions presented herein.

ENVIRONMENTAL MANAGEMENT ASSOCIATES, INC.

John O. Heggeness, R.G.
Senior Geologist

Dwight L. Carey, D.Env.
Principal

Corporate Office:
1698 Greenbriar Lane, Suite 210, Brea, California 92821-5919
(714) 529-3695 FAX: (714) 529-8543

Regional Office:
100 West Grove Street, Suite 100, Reno, Nevada 89509-4026
(702) 828-3939 FAX: (702) 828-3940

CHEMGOLD, INC. IMPERIAL PROJECT
IMPERIAL COUNTY, CALIFORNIA

SUPPLEMENTAL HYDROLOGY STUDY

TABLE OF CONTENTS

Page

LIMITATIONS i

LIST OF FIGURES iii

LIST OF TABLES iii

LIST OF APPENDICES iii

1. INTRODUCTION 1

2. CHEMGOLD PROJECT GROUND WATER SAMPLING AND ANALYSES AVAILABLE SINCE THE WESTEC REPORT 3

3. EMA GROUND WATER SAMPLING OF AUGUST 1996 3
   - 3.1. Introduction 3
   - 3.2. Field Methodology and Observations 3
   - 3.3. Results of Laboratory Analysis 7
   - 3.4. Results and Discussion 7

4. ADDITIONAL MONITORING WELL AND COREHOLE INFORMATION 10

5. MONITORING PLAN 14

6. PUMPING RATE OF PW-1 14

LIST OF FIGURES

Page

Figure 1: Imperial Project Vicinity Map 2
Figure 2: Location Map of Imperial Project Area Ground Water Coreholes and Wells 4
Figure 3: Piper and Stiff Diagrams 11
Figure 4: Monitoring Well MW-2 Construction Diagram 12

LIST OF TABLES

Page

Table 1: Well Sample Purge Volumes 5
Table 2: Water Quality Data from Project Monitoring Wells 8
Table 3: Water Quality Data From Project Coreholes and Non-Project Sources . . . 9
Table 4: Summary of Physical Data From Selected Piezometer Holes, Monitoring Wells, and Production Wells 13

LIST OF APPENDICES

APPENDIX A: ANALYTICAL RESULTS OF PREVIOUS SAMPLES

APPENDIX B: ANALYTICAL RESULTS OF AUGUST 1996 SAMPLING

CHEMGOLD, INC. IMPERIAL PROJECT
IMPERIAL COUNTY, CALIFORNIA

SUPPLEMENTAL HYDROLOGY STUDY

1. INTRODUCTION

Chemgold, Inc. has proposed the development of a conventional open-pit, heap leach, precious metal mine, the Imperial Project (Project), to be located in eastern Imperial County, California, approximately 45 miles northeast of El Centro, California and 20 miles northwest of Yuma, Arizona. The Project would be located south of State Route 78 and north of Interstate Highway 8, and would be accessed via Ogilby Road and Indian Pass Road (Figure 1). A joint Draft Environmental Impact Statement and Environmental Impact Report (EIS/EIR) is being prepared by the Bureau of Land Management (BLM) office in El Centro, California and the Imperial County Planning/Building Department.

In support of this EIS/EIR, WESTEC, Inc. prepared, in February 1996, a report entitled "Hydrology Baseline Report of the Imperial Project, Imperial County California" (WESTEC Report). Following the publication of the WESTEC Report, additional hydrogeologic data regarding Chemgold, Inc.'s proposed Imperial Project (Project) was generated by Chemgold, and certain additional questions regarding the area hydrogeology were raised. This report supplements the WESTEC Report and documents that additional hydrogeologic information developed by Chemgold, presents the results of water sampling and analyses conducted by Environmental Management Associates, Inc. (EMA) since the publication of the WESTEC Report, and utilizes this information to supplement some of the discussions presented in the WESTEC Report.

This report contains the following:

- Documentation of the analyses of the two (2) Project monitoring wells, MW-1 and MW-2, conducted by Chemgold subsequent to the publication of the WESTEC Report;

- Documentation of the sampling and analyses of MW-1, MW-2, EC-5 and WC-5 conducted by EMA subsequent to the publication of the WESTEC Report, as well as sampling and analyses of water from the existing Gold Rock Ranch well and Imperial Irrigation District's (IID's) All American Canal;

- A discussion of the methods used for constructing monitoring well MW-2 and information regarding the physical characteristics of the other Project wells and coreholes;

- A short discussion of the monitoring program requirements of the California Regional Water Quality Control Board, Colorado River Basin Region; and

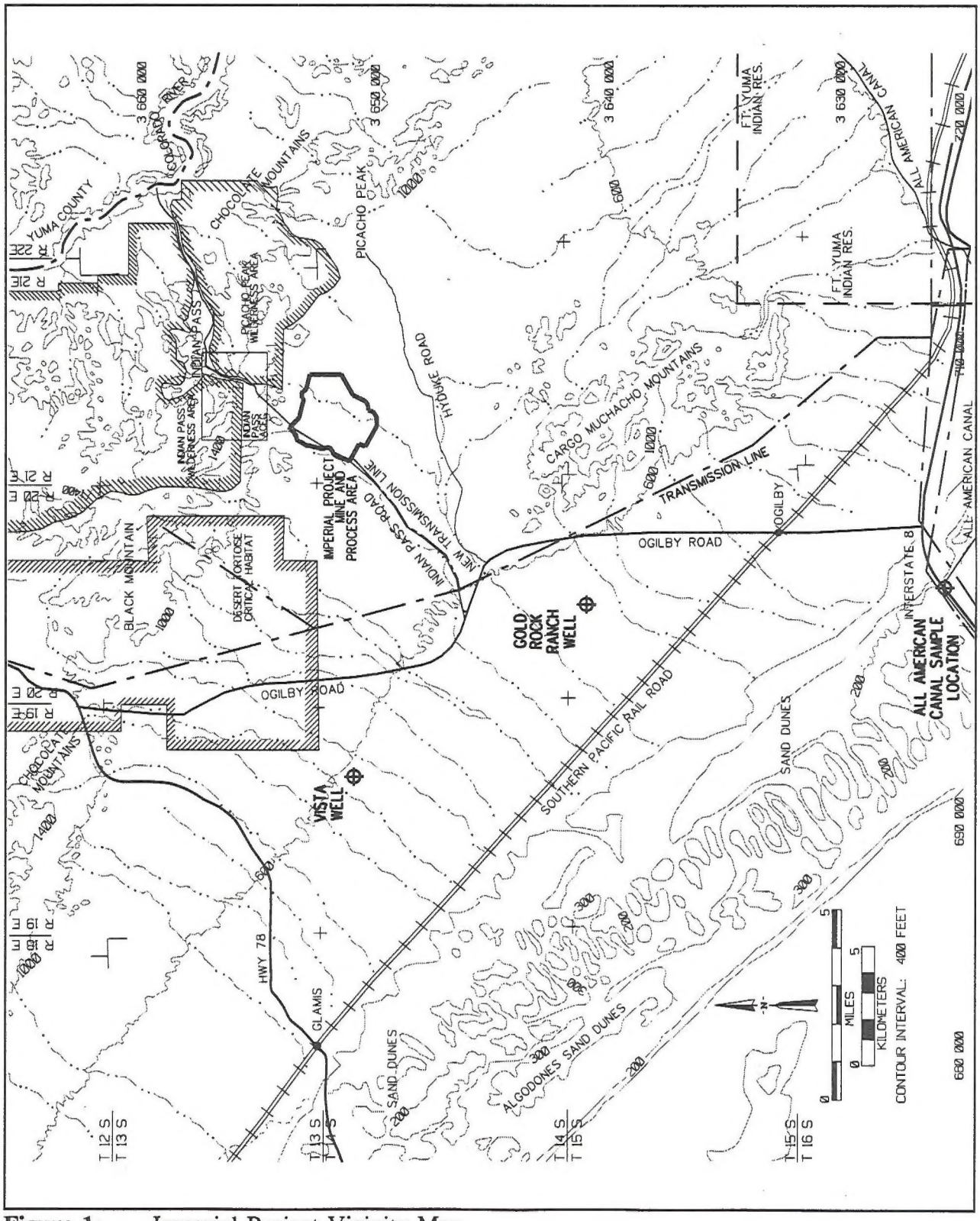


Figure 1: Imperial Project Vicinity Map

- A discussion of the recommended maximum pumping rate for water supply well PW-1 and the additional ground water production wells.

2. CHEMGOLD PROJECT GROUND WATER SAMPLING AND ANALYSES AVAILABLE SINCE THE WESTEC REPORT

Table 2 summarizes the analyses of ground water samples collected by Chemgold from the two (2) Project monitoring wells, MW-1 and MW-2, subsequent to the samples reported in the WESTEC Report. Laboratory data sheets are included in Appendix A. As indicated in Table 2, each of these samples were collected unfiltered and placed in laboratory-prepared sample collection bottles containing preservatives appropriate to the analyses.

3. EMA GROUND WATER SAMPLING OF AUGUST 1996

3.1. Introduction

Environmental Management Associates, Inc. (EMA) was retained to undertake sampling and analyses of the existing Project ground water monitoring wells and specified coreholes completed in the water table located within the Project mine and process area, and to undertake sampling and analyses of both the Gold Rock Ranch well and the IID's All American Canal. This section of this report documents this sampling and analysis.

3.2. Field Methodology and Observations

EMA staff supervised the sampling of the wells, coreholes and surface water source from August 28 through 30, 1996. Ground water samples were extracted from monitoring wells MW-1 and MW-2, and coreholes EC-5 and WC-5, located within the Project mine and process area, and from the water well located at Gold Rock Ranch, a small campground facility with a general store located approximately seven (7) miles southwest of the Project mine and process area. An additional sample was collected from the IID's All American Canal at the point west of the junction of Ogilby Road and Interstate 8 where Interstate 8 crosses the All American Canal. The locations of the Project wells and coreholes sampled are shown in Figure 2. The locations of the Gold Rock Ranch well and All American Canal sampling point are shown in Figure 1.

Prior to obtaining ground water samples from the onsite wells and coreholes, an attempt was made to purge at least three (3) casing volumes of water from each well or corehole through bailing in order to obtain samples as representative as possible of the ground water in the aquifer. Bailing was accomplished with the use of a truck-mounted winch using stainless-steel wire and either a 0.75-inch PVC or 1.0-inch or 1.5-inch stainless steel bailer (supplied by Chemgold). Conductivity, pH and temperature of the purged water from each well and corehole was field tested at least three (3) times per

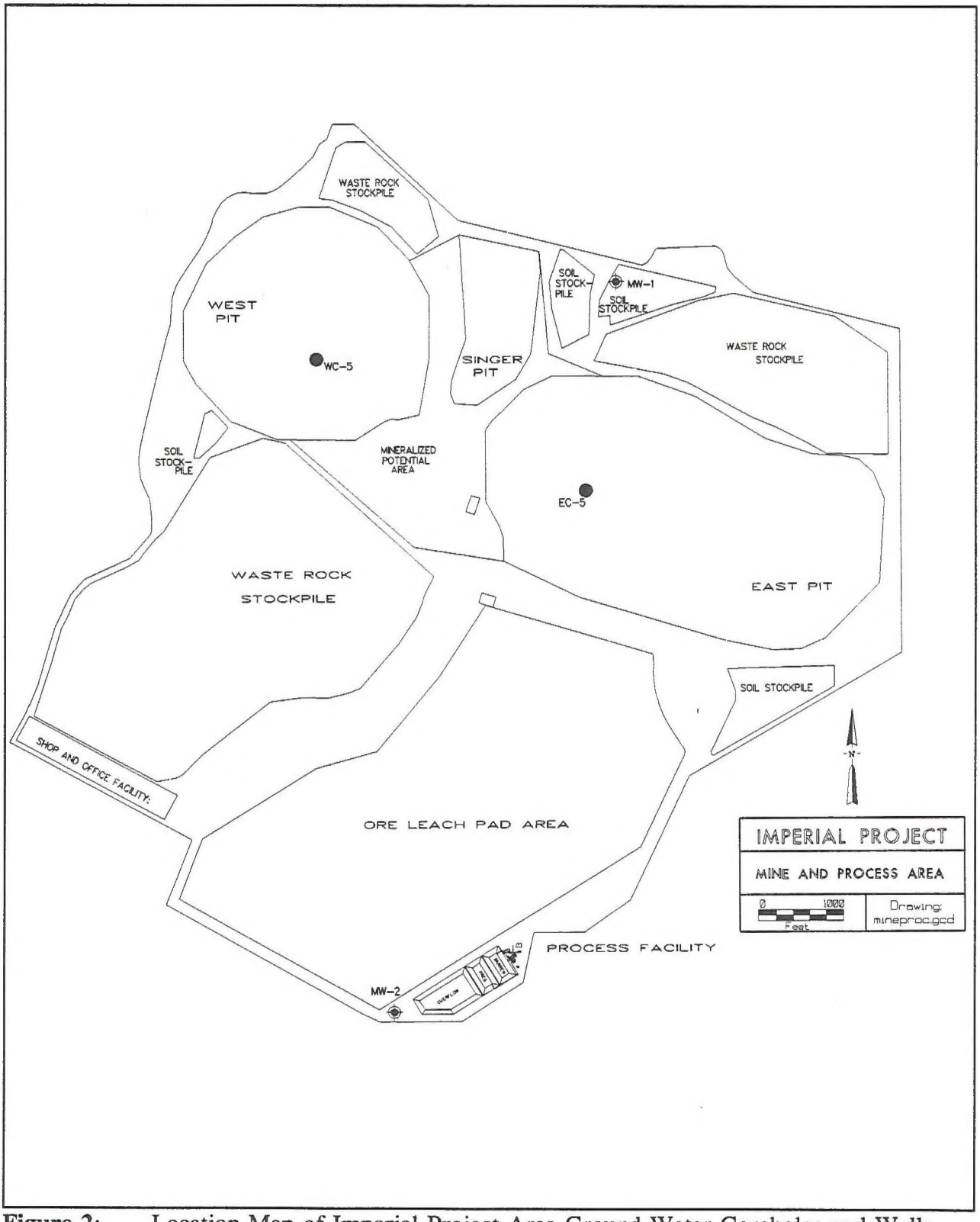


Figure 2: Location Map of Imperial Project Area Ground Water Coreholes and Wells

well or corehole prior to sampling. Purge water was disposed of on the ground.

The bailed ground water from WC-5, MW-1 and MW-2 appeared cloudy and contained a large amount of sediment, although both turbidity and sediment appeared to be decreasing with time. The bailed water from EC-5 was substantially less turbid and contained less sediment than the water bailed from the other wells and corehole, although it contained a substantial quantity of what appeared to be drilling fluid additives used during the drilling process. As the bailing progressed, field-tested conductivity, pH and temperature stabilized in the bailed water from each well or corehole. Due to time limitations, the reductions in turbidity and sediment, and the stabilization of field-tested conductivity, pH and temperature, purging was terminated after approximately 10 hours bailing each corehole (WC-5 and EC-5), and after approximately 4 hours bailing each well (MW-1 and MW-2), which resulted in the purging of the casing volumes indicated in Table 1.

Table 1: Well Sample Purge Volumes

Well Number/ Sample Location	Total Depth (ft bgs)	Depth to Water (ft bgs)	Casing Inside Diameter (inches)	Casing Volume (gal)	Casing Volumes Removed	Samples Collected[1]
WC-5	800	609.42	1.20	13	1.1	WC-5A/WC-5B
EC-5	800	722.22	1.20	5.4	2.4	EC-5A/EC-5B
MW-1	640	484.82	1.20	10	1.5	MW-1A/MW-1B
MW-2	880	626.18	1.75	26	1	MW-2A/MW-2B
Gold Rock Ranch	521	397	n/a	n/a	n/a	Gold Rock
All American Canal	n/a	n/a	n/a	n/a	n/a	A A Canal

[1] "A" samples filtered, "B" samples unfiltered. Both Gold Rock Ranch and AA Canal samples filtered
n/a not applicable or unknown

The Gold Rock Ranch ground water well supplies domestic water for the Ranch, and runs intermittently each day. Because the well is used each day, the well was purged by pumping for approximately 5 minutes before sampling.

Samples of the ground water from the Project wells and coreholes were obtained using the PVC or stainless steel bailer suspended on a stainless steel wire. The bailed water to be sampled was first placed in another filtering bailer which had been washed (see below). Except as noted below, one (1) set of samples from each well and corehole, designated the "A" samples, were field-filtered with a 0.45 μm filter into the

laboratory-prepared sample bottles which contained preservatives appropriate for the analysis. Because of the quantity of sediment in the samples, several filters were required for filtration of each sample. A second set of samples from each of the wells and coreholes, designated the "B" samples, were collected unfiltered in the laboratory-prepared sample bottles to duplicate the sample collection conditions which were used by Chemgold for its previous samples of ground waters from these wells and coreholes.

The unpreserved sample of WC-5A was not filtered in the field but filtered instead by the laboratory. All of the EC-5A samples were also not preserved nor filtered in the field, but were filtered by the laboratory. All of the collected samples were stored either in a refrigerator or on blue ice during collection, and were stored on blue ice during shipping. Chain-of-custody records were completed for the samples, and the samples were delivered to *Core Laboratories* on September 4, 1996.

All bailing and sampling equipment was cleaned with Liquinox and tap water, rinsed with tap water, and rinsed again with distilled water between wells and prior to each bailing and sampling activity.

Samples of the Gold Rock Ranch ground water well were collected from the tap immediately downstream of the well head and upstream of the storage tank. Samples were collected in a clean, unpreserved sample container, then field-filtered with a 0.45 μm filter into the laboratory-prepared sample bottles which contained preservatives appropriate for the analysis. Samples of the All American Canal were collected with a clean, unpreserved sample container, then field-filtered with a 0.45 μm filter into the laboratory-prepared sample bottles which contained preservatives appropriate for the analysis.

Core Laboratories was given instructions to analyze ground water samples from wells MW-1, MW-2, coreholes EC-5 and WC-5, and samples from the Gold Rock Ranch ground water well and the All American Canal for selected for Profile II analysis.

3.3. Results of Laboratory Analysis

Table 2 presents the analyses of both the filtered and unfiltered samples from the Project monitoring wells, and Table 3 presents the analyses of the filtered and unfiltered samples from the Project coreholes and the analyses of the samples collected from the Gold Rock Ranch well and the All American Canal. Laboratory data sheets are included as Appendix B.

3.4. Results and Discussion

The filtered samples from the Project wells and coreholes were collected to accurately establish the existing ground water chemistry of the Project mine and process area, while the unfiltered samples were collected for comparison to earlier unfiltered samples of the same Project wells and coreholes. The analyses presented in Table 2 and Table 3 indicate that all of the filtered samples from all of the Project wells and coreholes met all of the applicable California primary maximum contaminant levels (MCLs) for drinking water, and met all of the applicable secondary MCLs except as follows:

- All filtered samples exceeded the California secondary MCL for manganese and TDS;
- Monitoring well MW-2 exceeded the secondary MCLs for chloride and sulfate; and
- Corehole WC-5 exceeded the secondary MCLs for sulfate and iron.

All of the analyses from the filtered samples from the Project wells and coreholes also fell within the range of analyses from regional wells, as reported in the WESTEC Report.

Table 3 also shows the sample results from the Gold Rock Ranch well, which exceeded the secondary MCLs for chloride and TDS. These analyses are similar to the regional ground water quality reported in Table 7.1 of the WESTEC Report, which shows that the Vista, Gold Rock Ranch, Singer, and GF wells each exceed the secondary MCLs for chloride, sulfate and TDS. Table 3 also shows that the sample of water from the All American Canal exceeded the secondary MCLs for sulfate and TDS.

Table 2: Water Quality Data from Project Monitoring Wells

Element	Units	Current Drinking Water Quality Standards	Well Number							
			MW-1	MW-1	MW-1 A	MW-1 B	MW-2	MW-2	MW-2 A	MW-2 B
Collection Date			04/22/96	08/15/96	08/29/96	08/29/96	07/11/96	08/15/96	08/29/96	08/29/96
Field Filtering			unfiltered	unfiltered	filtered	unfiltered	unfiltered	unfiltered	filtered	unfiltered
Alkalinity	mg/l		183	171	163	186	246	169	95	195
Aluminum	mg/l	1.0 (1)/0.02 (2)	<0.1	0.3	<0.02	1.37	0.7	1.3	<0.02	4.03
Antimony	mg/l	0.006 (1)	<0.04	<0.003	<0.005	<0.005	<0.003	<0.003	<0.005	<0.005
Arsenic	mg/l	0.05 (1)	0.02	<0.005	<0.01	0.01	<0.005	<0.005	0.09	0.11
Barium	mg/l	1.0 (1)	0.2	<0.1	0.17	0.21	0.1	0.1	0.04	0.08
Beryllium	mg/l	0.004 (1)	<0.002	<0.002	<0.001	0.001	<0.002	<0.002	<0.001	0.002
Bismuth	mg/l		<0.1	<0.1	<1	<1	<0.1	<0.1	<1	<1
Boron	mg/l				0.50	0.53			4.95	5.06
Cadmium	mg/l	0.005 (1)	<0.0002	<0.002	<0.005	<0.005	<0.002	<0.002	<0.005	<0.005
Calcium	mg/l		53	34	49.4	57.1	64	80	67.3	108
Chloride	mg/l	250 (2)	91	39	56.1	61.1	130	120	641	606
Chromium	mg/l	0.05 (1)	<0.1	<0.1	<0.01	0.03	<0.1	<0.1	<0.01	0.07
Cobalt	mg/l		<0.1	<0.1	<0.03	<0.03	<0.1	<0.1	<0.03	<0.03
Conductance	μmhos/cm				832	832			2460	2460
Copper	mg/l	1.0 (2)	<0.1	<0.1	<0.01	<0.01	<0.1	<0.1	<0.01	0.03
Fluoride	mg/l	1.4 (1)	0.2	0.3	0.6	0.6	0.2	0.2	0.6	0.6
Gallium	mg/l		<0.1	<0.1	<0.5	<0.5	<0.1	<0.1	<0.5	<0.5
Iron	mg/l	0.3 (2)	<0.1	0.2	<0.03	4.39	0.5	1.7	<0.03	6.64
Lead	mg/l		<0.002	<0.005	<0.003	0.049	<0.003	<0.005	<0.003	0.024
Lithium	mg/l		<0.1	<0.1	0.04	0.06	<0.1	<0.1	0.58	0.67
Magnesium	mg/l		6.7	3.4	5.3	5.7	28	31	19.0	27.5
Manganese	mg/l	0.05 (2)	0.1	<0.1	0.70	1.10	<0.1	0.20	0.09	0.50
Mercury	mg/l	0.002 (1)	<0.0005	<0.0005	<0.0002	<0.0002	<0.0005	<0.0005	<0.0002	<0.0002
Molybdenum	mg/l		<0.1	<0.1	<0.05	<0.05	<0.1	<0.1	0.12	0.06
Nickel	mg/l	0.1 (1)	<0.1	<0.1	<0.04	0.04	<0.1	<0.1	<0.04	0.08
Nitrate Nitrogen	mg/l	10 (1)	<0.1	<0.1	0.13	0.05	0.2	0.3	0.07	<0.05
pH	mg/l	6.8 - 8.5	7.47	7.29	7.69	7.51	7.79	7.49	7.70	7.64
Phosphorous	mg/l		<0.1	<0.1	0.09	0.31	<0.1	<0.1	0.03	0.80
Potassium	mg/l		4.7	4.1	6	10	8.6	5.9	10	20
Scandium	mg/l		<0.1	<0.1	<0.01	<0.01	<0.1	<0.1	<0.01	<0.01
Selenium	mg/l	0.05 (1)	<0.001	<0.001	<0.01	<0.01	<0.001	0.001	<0.01	<0.01
Silver	mg/l	0.1 (2)	<0.0005	<0.002	<0.01	<0.01	<0.002	<0.002	<0.01	<0.01
Sodium	mg/l		160	150	159	135	140	150	537	463
Strontium	mg/l		4.5	0.3	4.28	4.19	1.3	1.3	2.57	2.61
Sulfate	mg/l	250 (2)	210	160	230	211	320	270	360	230
TDS	mg/l	500 (2)	656	529	620	640	728	804	1780	1690
Thallium	mg/l	0.002 (1)	<0.0005	<0.001	<0.002	<0.005	<0.001	<0.001	<0.002	<0.005
Tin	mg/l		<1	<0.5	<0.05	<0.05	<1	<0.5	<0.05	<0.05
Titanium	mg/l		<0.1	<0.1	<0.01	<0.01	<0.1	0.1	<0.01	0.01
Vanadium	mg/l		<0.1	<0.1	<0.05	<0.05	<0.1	<0.1	<0.05	<0.05
Zinc	mg/l	5.0 (2)	<0.1	<0.1	<0.01	0.06	<0.1	0.1	<0.01	0.26

(1) California Primary Maximum Contaminant Limit (2) California Secondary Maximum Contaminant Limit

Table 3: Water Quality Data From Project Coreholes and Non-Project Sources

Element	Units	Current Water Quality Standards	EC-5 A	EC-5 B	WC-5 A	WC-5 B	Gold Rock	AA Canal	Trip Blank
Collection Date			8/30/96	8/30/96	8/28/96	8/28/96	8/30/96	8/30/96	8/27/96
Filed Filtering			filtered	unfiltered	filtered	unfiltered	filtered	filtered	
Alkalinity	mg/l		400	910	201	202	75	154	<5
Aluminum	mg/l	0.02 (2)	<0.02	0.54	<0.02	0.32	<0.02	<0.02	<0.02
Antimony	mg/l	0.006 (1)	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Arsenic	mg/l	0.05 (1)	<0.01	0.03	<0.01	<0.01	0.01	<0.01	<0.01
Barium	mg/l	1.0 (1)	<0.01	0.07	0.03	0.07	0.06	0.12	<0.0
Beryllium	mg/l	0.004 (1)	0.002	<0.001	0.001	<0.001	<0.001	<0.001	<0.001
Bismuth	mg/l		<1	<1	<1	<1	<1	<1	<1
Boron	mg/l		0.12	0.24	0.74	3.29	0.90	0.16	<0.05
Cadmium	mg/l	0.005 (1)	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Calcium	mg/l		32.3	221	59.4	85.1	31.0	86.4	<0.1
Chloride	mg/l	250 (2)	204	1450	162	144	351	119	<0.5
Chromium	mg/l	0.05 (1)	<0.01	0.11	<0.01	0.08	<0.01	<0.01	<0.01
Cobalt	mg/l		<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Field Conductance	µmhos/cm		1683	1683	1290	1290	880	1920	n/a
Copper	mg/l	1.0 (2)	<0.01	0.07	<0.01	0.02	<0.01	<0.01	<0.01
Fluoride	mg/l		0.8	0.8	0.8	0.8	3.0	0.6	<0.1
Gallium	mg/l		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Iron	mg/l	0.3 (2)	0.11	2.36	0.60	2.66	<0.03	<0.03	<0.03
Lead	mg/l		<0.003	0.008	<0.003	0.014	<0.003	<0.003	<0.003
Lithium	mg/l		0.08	0.20	0.07	0.08	0.09	0.06	<0.01
Magnesium	mg/l		5.3	37.7	16.1	27.4	0.6	32.8	<0.1
Manganese	mg/l	0.05 (2)	2.01	20.1	0.47	0.35	<0.01	<0.01	<0.01
Mercury	mg/l	0.002 (1)	0.0005	0.0027	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Molybdenum	mg/l		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Nickel	mg/l	0.1 (1)	<0.04	0.10	<0.04	0.14	<0.04	<0.04	<0.04
Nitrate Nitrogen	mg/l	10 (1)	0.44	<0.05	0.06	0.11	1.52	0.35	<0.05
pH	mg/l	6.8 - 8.5	8.48	7.43	7.61	7.59	7.74	8.10	12.84
Phosphorous	mg/l		0.66	0.07	0.03	0.13	0.02	<0.01	<0.01
Potassium	mg/l		26	18	12	10	6	6	<5
Scandium	mg/l		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Selenium	mg/l	0.05 (1)	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01
Silver	mg/l	0.1 (2)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Sodium	mg/l		194	349	233	176	300	137	<1
Strontium	mg/l		0.67	5.46	1.30	1.35	1.01	1.23	<0.01
Sulfate	mg/l	250 (2)	140	130	310	324	130	309	<10
TDS	mg/l	500 (2)	4440	6010	1160	1060	920	820	20
Thallium	mg/l	0.002 (1)	<0.002	<0.005	<0.002	<0.005	<0.002	<0.002	<0.002
Tin	mg/l		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Titanium	mg/l		<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Vanadium	mg/l		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Zinc	mg/l	5.0 (2)	<0.01	0.12	<0.01	0.14	0.02	0.01	<0.01

(1) California Primary Maximum Contaminant Limit (2) California Secondary Maximum Contaminant Limit

Piper and Stiff diagrams were constructed for the filtered samples from Project monitoring wells MW-1 and MW-2, for the filtered samples from coreholes EC-5 and WC-5, for the current Gold Rock Ranch and All American Canal samples, and for the data presented in the WESTEC Report for the Vista well and the Project ground water production well PW-1 (insufficient information was available in the WESTEC Report to prepare diagrams for the other reported wells) (see Figure 3). The Stiff diagrams indicate that the dominant cation species are sodium and potassium for all samples, while the dominant anion varies from sulfate and carbonate/bicarbonate near the Project mine and process area to chloride and sulfate in the alluvial basin. The Piper diagrams also show that the dominant cations for all the water samples are sodium and potassium. The Piper diagrams also show that near the Project mine and process area there is no clearly dominant anion, but shows that the dominant anion is chloride in the alluvial aquifer downgradient from the Project mine and process area.

Comparisons of the analyses of the current filtered and unfiltered samples indicate that the concentrations of some metals in the filtered samples were substantially lower than the concentrations of the same metals in the unfiltered samples. While iron and aluminum concentrations in both monitoring wells were below detection levels in the filtered samples, the unfiltered samples had substantial concentrations of both. Manganese concentrations were substantially lower in the filtered samples than the unfiltered samples, and the concentrations from the unfiltered samples correlate well with the regional manganese concentrations reported in the WESTEC Report. TDS, sulfate and chloride concentrations appear to be unaffected by the field-filtering prior to preservation. A comparison of the analyses of the late-August unfiltered samples and all of the other unfiltered samples from the same hole or well did not indicate any significant chemical species variations.

4. ADDITIONAL MONITORING WELL AND COREHOLE INFORMATION

The following presents a discussion of the construction methods used for monitoring well MW-2, as obtained from Chemgold, and a brief elaboration of the aquifer testing conducted by WESTEC, as obtained from WESTEC.

Monitoring Well MW-2 was drilled and installed in June 1996. As shown in Figure 4, the well was constructed with 2-inch diameter schedule 80 PVC to a total depth of 800 feet bgs. Forty feet of 0.040 inch screen was installed at the base of the well with 760 feet of blank casing extending to the surface. A pack of clean pea gravel was installed in the annular space to cover the screen and a bentonite seal was placed over the gravel pack. Three-quarter (3/4)-inch washed gravel extends from the bentonite seal to within 50 feet of the surface, and a cement seal was placed from the 50-foot depth to the surface.

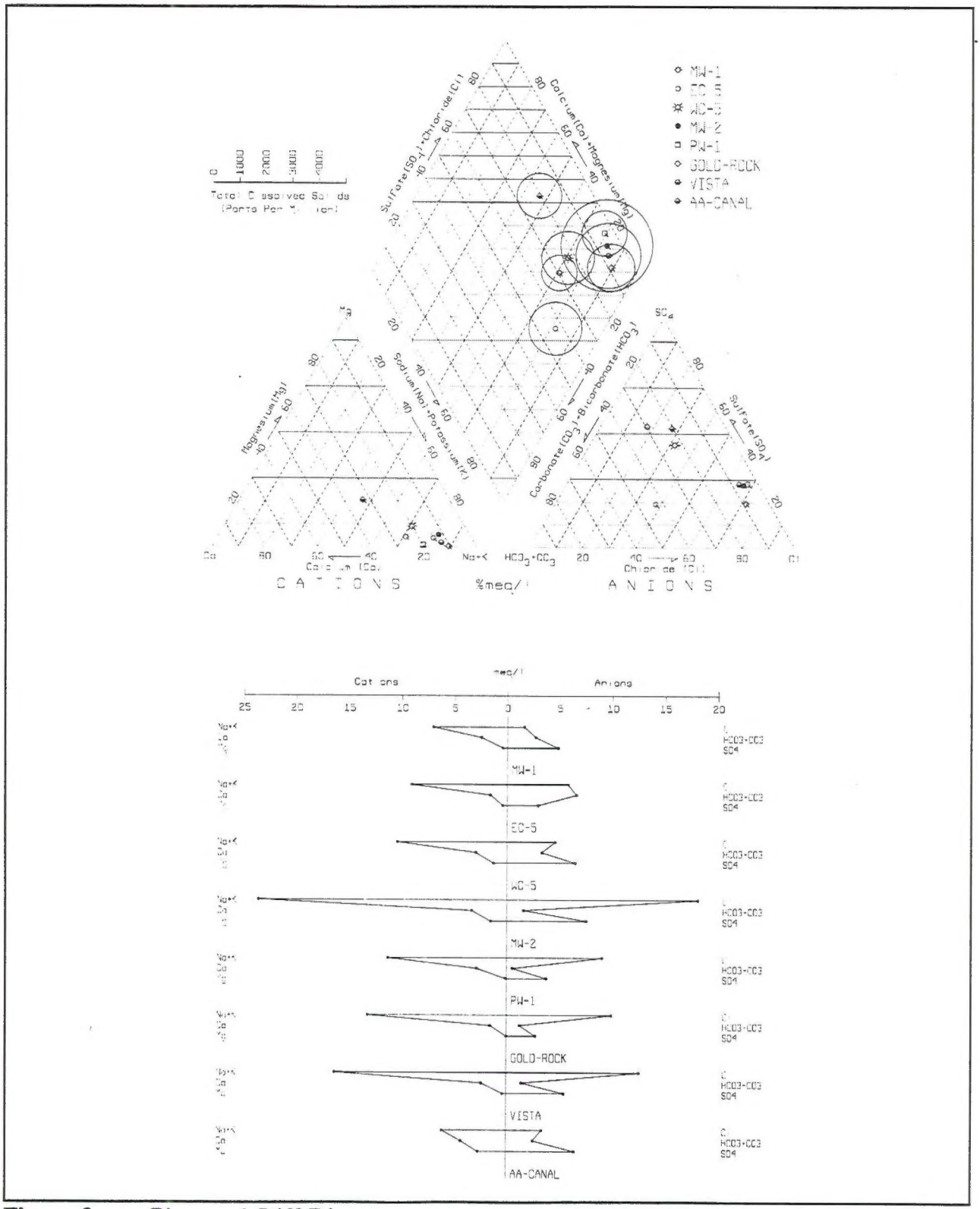


Figure 3: Piper and Stiff Diagrams

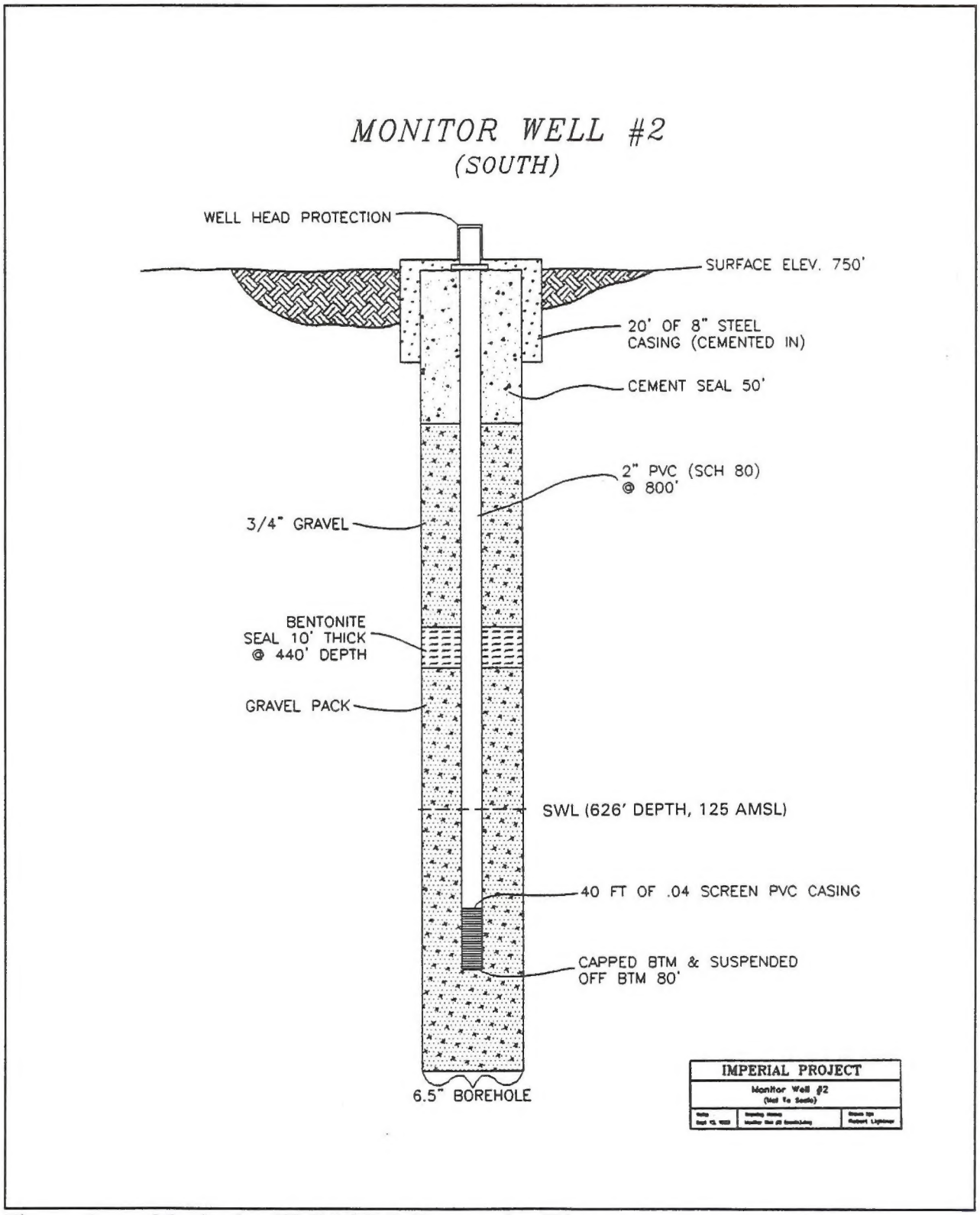


Figure 4: Monitoring Well MW-2 Construction Diagram

Aquifer testing was performed by WESTEC only on a limited number of wells and holes. A pumping test was performed only on production well PW-1 because the casings in all other holes were too small, and the water levels too deep, to allow a sufficient volume of water to be pumped from the holes to conduct a meaningful test. Falling head tests were performed on coreholes EC-5, WC-5, H-4 and H-5, but because of the long (40-foot) screened interval and high aquifer permeability in both H-4 and H-5, these holes could not be filled with enough water to accurately measure the falling head. However, WESTEC was able to conduct slug tests on all four (4) of these Project holes.

Table 4 lists each of the wells installed, or coreholes completed to sample ground water, for the Project, and indicates the proposed use, location, total depth, depth to static water level, and the aquifer each well or corehole is completed in.

Table 4: Summary of Physical Data From Selected Piezometer Holes, Monitoring Wells, and Production Wells

Hole Number	Location	Total Depth	Depth to Static Water	Aquifer
		(ft bgs)		
Piezometer Holes				
94H-1	Mine and Process Area	1,000	657.2	Alluvial (unconfined)
EC-5	Mine and Process Area	800	720	Bedrock
WC-5	Mine and Process Area	800	606	Bedrock
WR-2	Mine and Process Area	945	694.5	Alluvial (unconfined)
H-4	Mine and Process Area	1,000	544.6	Alluvial (confined)
H-5	Mine and Process Area	1,080	594.5	Bedrock
H-6	Mine and Process Area	920	631.5	Alluvial (confined)
Monitoring Wells				
MW-1	Mine and Process Area	640	479.7	Conglomerate (confined)
MW-2	Mine and Process Area	880	626	Bedrock
Production Wells				
PW-1	Water Supply Area	960	544.4	Alluvial (confined)

5. MONITORING PLAN

The California Regional Water Control Board, Colorado River Basin Region (CRWQCB) requires that each applicant for Waste Discharge Requirements (which authorizes the discharge of wastes to land) prepare and submit a monitoring plan, which must be approved by the CRWQCB prior to the commencement of discharges. Typically required by the CRWQCB in the monitoring plan is the installation and regular monitoring of a vadose (unsaturated) zone monitoring system, which would be installed to detect potential leaks of liquid waste or leachate into the vadose zone prior to any discharge into the underlying ground water, and wells completed in the uppermost aquifer both upgradient and downgradient of the waste management unit (WMU) to monitor the ground water in this aquifer prior to, during, and following the authorized discharge of waste to land. Both the vadose zone monitoring system and the ground water monitoring wells would be required to be sampled regularly for "constituents of concern," which would be identified, based upon the nature of the waste to be discharged and the constituents in the ground water, prior to discharge. Consistent sampling, analyses and reporting would be required by the CRWQCB, such that any significant changes in the monitoring results may indicate the introduction of constituents into the ground water from the waste.

6. PUMPING RATE OF PW-1

WESTEC recommended a average maximum pumping rate of 550 gpm for production well PW-1. This pumping rate was based on individual well specifics determined during the aquifer pumping test conducted by WESTEC. A average maximum pumping rate of 550 gpm from production well PW-1 was estimated as a safe withdrawal rate which would prevent possible damage to the well or pumping system due to excessive drawdown in the well. If the efficiency of the well can be increased by subsequent additional well development, the pumping rate of well PW-1 may be safely increased to that rate determined appropriate by the well production engineer. If and/or when additional production wells are installed for the Project, an average maximum pumping rate should be established by the well production engineer for each well which prevents excessive drawdown or possible damage to the specific well or pumping system.

APPENDIX A

ANALYTICAL RESULTS OF PREVIOUS SAMPLES

The information otherwise contained in this
Appendix/Attachment has been deleted from the
Draft Environmental Impact Statement/Environmental Impact Report (DEIS/EIR).

This deleted information can be found in its entirety at the
Bureau of Land Management
El Centro Resource Area Office

APPENDIX B

ANALYTICAL RESULTS OF AUGUST 1996 SAMPLING

The information otherwise contained in this
Appendix/Attachment has been deleted from the
Draft Environmental Impact Statement/Environmental Impact Report (DEIS/EIR).

This deleted information can be found in its entirety at the
Bureau of Land Management
El Centro Resource Area Office

APPENDIX F - VEGETATION BASELINE SURVEY, IMPERIAL PROJECT, IMPERIAL COUNTY, CALIFORNIA

VEGETATION BASELINE SURVEY

IMPERIAL PROJECT

IMPERIAL COUNTY, CALIFORNIA

Prepared for:

Chemgold, Imperial Project
P.O. Box 758
Winterhaven, CA 92283

Prepared by:

Samuel A. Bamberg, Ph.D.
Ingrid E. Hanne, M.S.
Bamberg Associates
26050 E. Jamison Circle
Aurora, Colorado 80015

August 1995

TABLE OF CONTENTS

Page

1.0 INTRODUCTION 1

2.0 SITE DESCRIPTION 1

3.0 VEGETATION ANALYSIS METHODS 4

4.0 RESULTS OF SURVEYS 5
4.1 General Description 5
4.2 Vegetation Types and Mapping 6
4.3 Plant Species Present 12
4.4 Results of Quantitative Vegetation Surveys 12
4.4.1 Vegetative and Ground Cover 12
4.4.2 Perennial Plant Diversity and Density 14

5.0 SUMMARY AND DISCUSSION 17

LIST OF FIGURES

Figure 2-1 Map of Imperial Project Area, June 1995. 2
Figure 4-1 Map of vegetation types, Imperial Project, June 1995 7
Figure 4-2 A desert pavement area showing lack of vegetation on gravel surface, Imperial Project, June 1995 9
Figure 4-3 Example of a broad upland flat and slope showing low vegetative cover, Imperial Project, June 1995 9
Figure 4-4 A large wash showing bare, sandy channel and well vegetated banks, Imperial Project, June 1995 11
Figure 4-5 A shrub community in a shallow wash showing good vegetative cover, Imperial Project, June 1995 11

LIST OF TABLES

Table 4-1 Identification and Locations for Vegetation Surveys for Imperial Project, June 1995 13
Table 4-2 Summary of Average Percent Ground Cover Results for Vegetation Transects, Imperial Project, June 1995. 14
Table 4-3 Summary of Shrub Density and Diversity Results, Imperial Project, June 1995. 15
Table 4-4 Perennial Species Count in Transects, Imperial Project, June 1995. 16
Table A-1 List of Plant Species at Imperial Project, June 1995. 19

1.0 INTRODUCTION

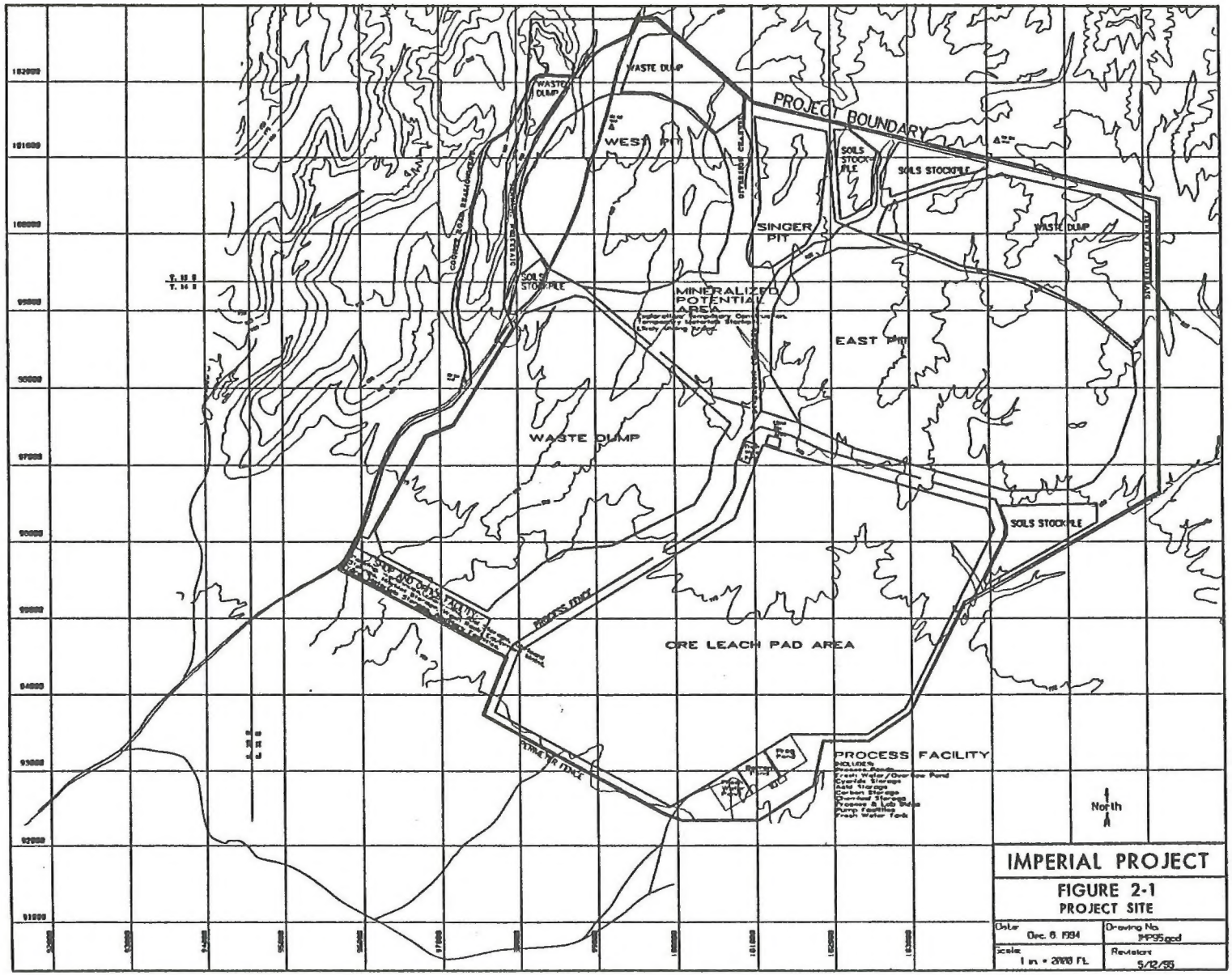
In this report we present the baseline vegetation analysis for the Imperial Project for Chemgold, Incorporated. This project is a proposed gold mine located in Imperial County, California, in the Sonoran Desert about 15 miles west of the Colorado River. Our study involved an intensive field trip to the site to coordinate, design the program, and to conduct the vegetation surveys. This baseline report presents information on the vegetation resources with emphasis on present vegetative conditions. This study provides information in sufficient detail to support state and federal environmental review and permitting requirements, and to determine impacts of proposed actions. Our quantitative descriptions include percent of vegetative cover in addition to density and diversity measurements.

The vegetation data we collected provides information for the following activities or requirements:

- support the application for a use permit and Plan of Operations and reclamation planning,
- support and supply information for an EIS, and
- provide species identification and estimated densities for permitting, clearing, and salvage of protected native plants.

2.0 SITE DESCRIPTION

The general study area encompassed the project site plus a buffer zone of about 200 feet for a total of approximately 1700 acres. The project site is at an elevation of 750 to 875 feet in a broad relatively flat dissected drainage basin southeast of the Chocolate Mountains. The Imperial Project is located in Imperial County, California, 45 miles northeast of El Centro and 5 miles west of Ogilby Road (see map on Figure 2-1). The landform consists of a type of dissected old river alluvial or piedmont deposits that have formed upland flats and gentle slopes interspersed with narrowly incised washes in broader drainages. The areas surrounding the project site are low mountain ranges; the Chocolate Mountains to the northwest, Cargo Muchachos to the southeast, Picacho Peak and Indian Pass to the north and east, and open to the southwest. Large drainage areas cross the site from the Indian Pass area to the northeast. Drainage is to the southeast in a series of well defined dry watercourses (washes) from the Indian Pass crest to the northeast to the Algodones Dunes in the southwest. The


PROJECT BOUNDARY
WASTE DUMP
WEST PIT
SOILS STOCKPILE
SINGER PIT
MINERALIZED POTENTIAL AREA
EAST PIT
WASTE DUMP
SOILS STOCKPILE
ORE LEACH PAD AREA
PROCESS FACILITY
North
IMPERIAL PROJECT
FIGURE 2-1
PROJECT SITE
Date: Dec. 6, 1984
Drawing No.: IMP95.ged
Scale: 1 in. = 2000 FT.
Revised: 5/12/85

area topographically is characterized by low upland hills and flats with desert pavement surfaces interspersed with narrow dry washes.

The rock substrate over most of the site is a cemented alluvium covered by shallow soil with a broken discontinuous layer of basaltic cobbles and boulders from an eroded igneous outflow. The flats and uplands have lag gravel surfaces with a thin to non-existent residual soil layer overlying the cemented alluvium. These old erosional deflation surfaces are covered with gravel and boulders that have turned black due to oxidation of the rock minerals by the intense sunlight and heat, these surfaces on the rocks are referred to as desert varnish. The light and heat also bakes the soil surface around the rocks which forms a water impenetrable surface and, together with the varnished rocks, referred to as desert pavement. These surfaces support very little vegetation.

Narrow bands of sand and silt material accumulate in shallow washes and underneath shrubs. Shallow wash bottoms accumulate soil material up to a foot and a half deep. The larger, more active washes have a thin to deep veneer of recently deposited gravel and rock in the wash bottoms and fine sand along the channel sides. Channels are deeply incised in the washes, and the gravelly bottom channels support no vegetation. This erosional material moves through the site by the flushing action of water flow following infrequent storm events. Vegetation is absent in the active channels, but is abundant on the stable banks and shallow side washes.

The washes flow only after storms, otherwise they are dry. We observed no springs, seeps, or permanently wet areas or wetlands during our comprehensive surveys on the project site. Water pools for a short time after rains in depressions in the sandy, gravelly washes. We did not observe or collect any wetland plants or wet soils in the area. The weather this spring season of 1995 had abundant moisture with significant rains, and the washes flowed for a short period of time. The weather patterns the last three years have been a wet cycle with periods of heavy rainfall that have produced excellent plant growth.

The weather patterns the last three years have been extremely favorable for plant growth and productivity. Late fall and winter rains have been favorable in 1991, 1992, and 1993. The

winter season of 1994/1995 has been cool and rainy. When we conducted the surveys in June, there was good growth by perennial trees and shrubs, and by herbaceous annuals. The vegetative growth this season, and for the past three years has been the highest in the past 15-20 years. The results have been an increase in the growth of the perennial shrubs, and significant cover and productivity by annuals. The results of the vegetation surveys should be interpreted as representing the highest cover and diversity possible for the Imperial Project area. During a series of years with low rainfall, the cover can be less than a fourth of the values measured during this very favorable year.

3.0 VEGETATION ANALYSIS METHODS

We adapted the field surveys methods to sample the type of desert vegetation present in the study area and to increase the data's usefulness in estimating cover and determining shrub density. The quantitative vegetation survey technique we used utilized transects of linear plots laid end to end along straight compass lines and oriented parallel to the slopes and gradients. The vegetation type and patterns were qualitatively related to the abiotic factors of topographic position, erosion features, and soil types. Each transect was made up of 10 or 12 plots of variable size. In each plot, vegetative variables were recorded on standardized field data forms.

We conducted the quantitative field surveys on June 2 and 3, 1995. The locations, number of samples, variables recorded, and data analysis methods were determined as described below.

Sampling Locations

Nine transects were located to sample the major vegetation types in topographic locations typical for the site.

Number of Samples

Ten or twelve plots per linear transect were sampled in each of the 9 locations.

Variables

The variables were chosen to determine vegetation characteristics. The variables in the

transects measured for vegetation were:

- percent cover by each plant species,
- total percent vegetative cover (also vegetative litter, rock, and bare ground), and
- total number and average size of shrubs (for density).

The percent cover of each plant species within each linear meter plot was determined by a visual estimation technique. We grouped all the plants of one species as a unit and visually assigned a cover value. Individual shrubs by species were counted in each plot. The aspect and degree of slope were measured with a Brunton compass. We estimated total percent vegetative cover visually, with the rock, vegetative litter, and bare ground estimates adding up to 100% ground cover.

We analyzed the transects for the vegetation parameters of ground cover, density, and diversity. Total vegetative ground cover was determined by averaging the estimated cover for all plots in each transect. Perennial shrub and tree densities were calculated by adding up the shrub/tree counts in each plot, averaging this number for all plots in a transect, and then adjusting this average per plot to a hectare and acre basis. Diversity was the total number of perennial plant species (shrubs, cactus, and trees) recorded in the plots along transects.

4.0 RESULTS OF SURVEYS

Vegetation on the project study area is typical for this hot, dry desert region of southern California. The vegetation consists of drought resistant perennial species, and annual species that germinate after sufficient rains. In this section, we present the results of the qualitative and quantitative field surveys conducted. The vegetation types and characteristics are discussed in relationship to topography, soils, and other abiotic factors. The plant community analysis and vegetation parameters of concern for determining reclamation success are calculated and presented.

4.1 General Description

The vegetation on the project site is low desert scrub typical of the severe temperate desert areas. The low rainfall (annual average of 4½ inches measured during the past 10 years) and the high daytime temperature (up to 115 degrees fahrenheit in the summer) of the project area

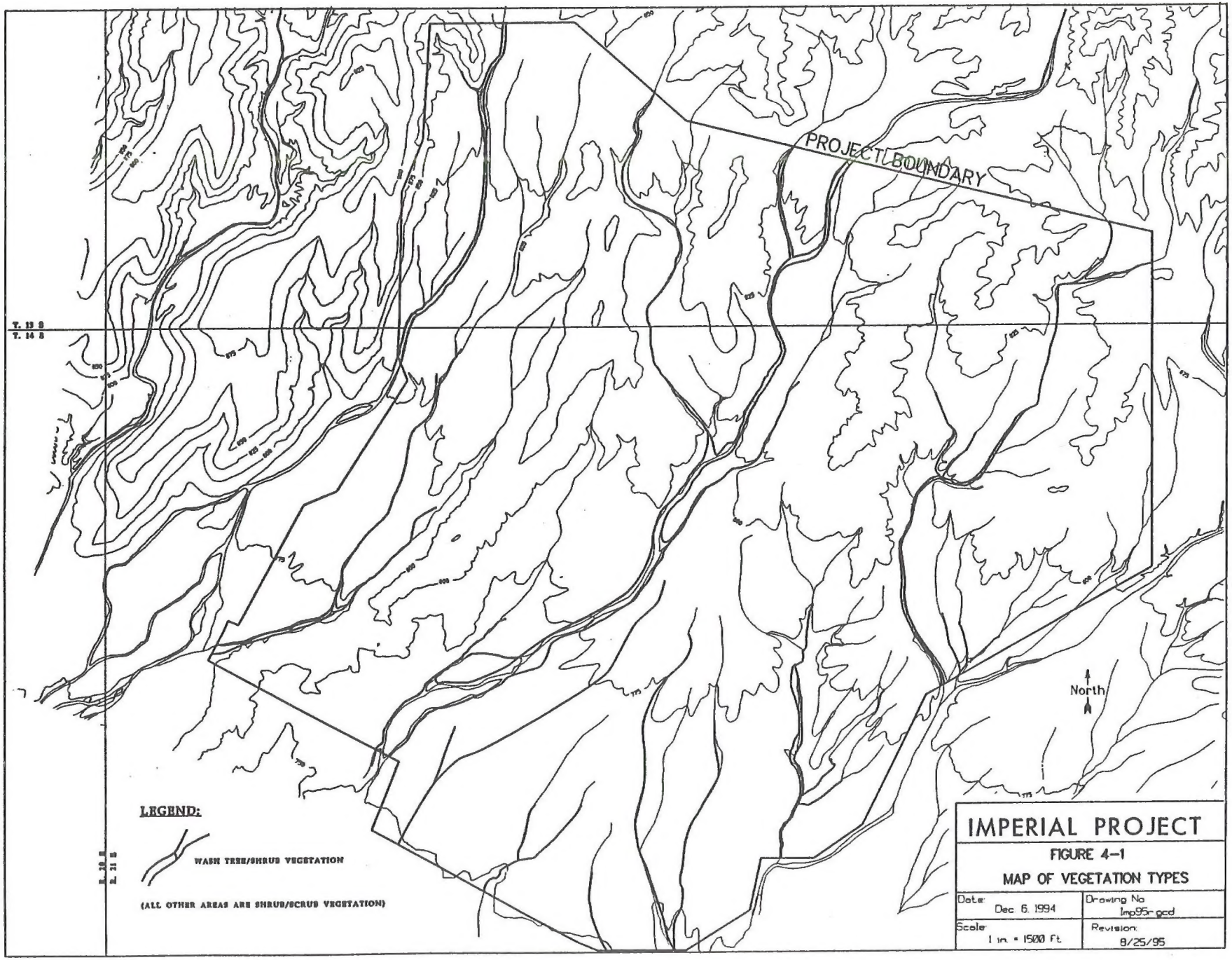
impose special requirements on the plant life. Vegetative cover is extremely low and species diversity is minimal. The existing vegetation is highly adapted to the desert heat and droughts. The vegetation community on the entire study area is a mixed desert scrub characterized by *Larrea tridentata* (creosote bush) and *Ambrosia dumosa* (burrobush). The perennial shrubs are the dominant vegetation, with a few herbaceous perennials present. Cover and productivity by annual species is dependent on seasonal moisture. In particular, the seasonal timing and amounts of rain are important. Autumn rains generally germinate the annuals, and late winter and spring rains promote growth. Rains were abundant this year after mid-December, so annual germination was moderate.

Previous human use impacting vegetation in the project site included roads and access trails and some previous trenching for exploration in the rock outcrop area. Plants have been periodically collected or cut, in particular, many of the older ironwood trees had been cut and were left as old stumps or resprouted bases on sides of washes throughout the project site.

4.2 Vegetation Types and Mapping

The vegetation in this portion of the Sonoran Desert is generally typed into one category, the creosote shrub type. For this report and reclamation purposes, we have divided the vegetation type in all locations of natural or semi-natural state into 2 types. These are: 1) a shrub/scrub vegetation type on the open, drier alluvial flats and slopes and 2) a tree/shrub vegetation type on sides of washes and drainages. Refer to Figure 4-1 for a map of these types. The shrub/scrub vegetation type is typical of the creosote type with shrubs being dominant and widely spaced. The tree/shrub vegetation type reflects the higher moisture availability in washes and drainages which results from rain run-off events. The vegetation on sides of the washes has greater diversity, variability, and ground cover.

The vegetation within each type differs in species distribution and abundance by location within the site, partly due to segregation of species into topographic features. There are broad patterns of vegetation related to topographic controls of soils and moisture. We have further divided the two vegetation types into subtypes based on species abundance due to their topographic positions.


PROJECT BOUNDARY
T. 13 S
T. 14 S
R. 30 E
R. 31 E
North
LEGEND:
WASH TREE/SHRUB VEGETATION
(ALL OTHER AREAS ARE SHRUB/SCRUB VEGETATION)
IMPERIAL PROJECT
FIGURE 4-1
MAP OF VEGETATION TYPES
Date: Dec 6, 1994
Drawing No: Imp95rged
Scale: 1 in. = 1500 Ft.
Revision: 8/25/95

Shrub/Scrub Vegetation Type

The open, dry alluvial flats and gentle slopes have a shrub/scrub vegetation type which consists of low shrubs and cactus which are widely spaced. The major species of shrubs measured in the transects were (in order of abundance): *Encelia farinosa* (inciensio), *Ambrosia dumosa* (burrobush), *Larrea tridentata* (creosote bush), and *Opuntia bigelovii* (teddy-bear cholla). This type occupies 95% of the 1,565 acres of the project site, and includes all of the desert pavement areas. On portions of the alluvial flat and slope areas, desert pavement has developed and the vegetative ground cover is almost non-existent (less than 0.3%). The shrub/scrub vegetation is spotty and variable in distribution and species dominance.

As a basis for vegetation typing in the reclamation planning, we identified three topographic subtypes of shrub/scrub vegetation type, these are: 1) desert pavement, 2) alluvial flats and slopes, and 3) rock outcrop/thin soil.

- The desert pavement occurs on alluvial flats on old undisturbed surfaces and covers the majority of the site. These flat to shallow sloping sand and rock surfaces weather in-place by the sun and arid climate and form an impenetrable surface with high salt content (see Figure 4-2). We estimate these surfaces to be between 1,000 and 100,000 years old, and cover an estimated 35% of the uplands. Vegetation is extremely scarce, water and seeds generally cannot penetrate the surface. The estimated ground cover for the desert pavement is 0 to 0.5%. This subtype will not serve as a basis for reclamation planning since the soil and surface conditions cannot be restored during mine reclamation.

- The alluvial flats and slopes occurs in most upland areas and covers approximately 64% of the uplands and flats. These are areas within the desert pavement topography that have had their alluvial surfaces disturbed by erosion or deposition within the last 1,000 years. They are interspersed with desert pavement surfaces. Spacing of the plants is clumped and clumping is dependant on soil type, topographic position, and water availability (see Figure 4-3). Vegetative ground cover is higher than the desert pavement and was measured at 7 to 9%.



Figure 4-2 A desert pavement area showing lack of vegetation on gravel surface, Imperial Project, June 1995



Figure 4-3 Example of a broad upland flat and slope showing low vegetative cover, Imperial Project, June 1995

- The rock outcrop/thin soil areas occur on a small portion, about 1%, of the north-central portion of the site. Vegetation grows in the cracks of and between the rocks. The density of the vegetation is very low and is clumped around the available thin soil deposits and cracks in the rocks. The rocks have been highly baked by the sun and arid climate. An estimated 2 to 4 percent of the ground was covered by vegetation this season.

Tree/Shrub Vegetation Type

The tree/shrub vegetation type occurs o the sides and banks of washes created by the major water runoff from the upslope large drainage basins during significant precipitation events. This type covers a small percentage of the site at 5% (90 acres). Flooding and washing of the old alluvial material creates channels and disturbs the old, weathered surfaces. This allows better penetration of water and seed, and permits a higher cover than on the shrub/scrub vegetation type. A greater variety of plant species and a higher abundance of plants is the results. The major species include those found in the shrub/scrub vegetation type plus other species of trees and shrubs which occur principally in the washes. We identified two topographic subtypes of shrub/scrub vegetation type; these are: 1) broad major washes and 2) shallow subsidiary washes.

- The broad major washes form in the drainages that cross the study area and continue out onto the broad alluvial flats southwest toward the Algodones Dunes. These washes vary from almost flat to 15 feet deep and 8 to 225 feet (average 40 feet) wide. The sides of the washes are sandy and support trees and plants (normally above the high water mark), and occasional islands of thick vegetation form on raised islands of the wider sandy bottoms (see Figure 4-4). Vegetation in the major wash areas is the most abundant and diverse on the Imperial Site. Trees associated with the major washes include *Olynea tesota* (ironwood) and *Cercidium floridum* (palo verde), and several species of shrubs that occur mainly in washes such as *Bebbia juncea* (sweetbush) and *Hyptis emoryi* (desert lavender). Plant cover varies from 0% in sandy bottom areas to 66% (measured this year) on some sides and mid-wash vegetative clumps.

This page intentionally left blank
for reproduction purposes.



Figure 4-4 A large wash showing bare, sandy channel and well vegetated banks, Imperial Project, June 1995

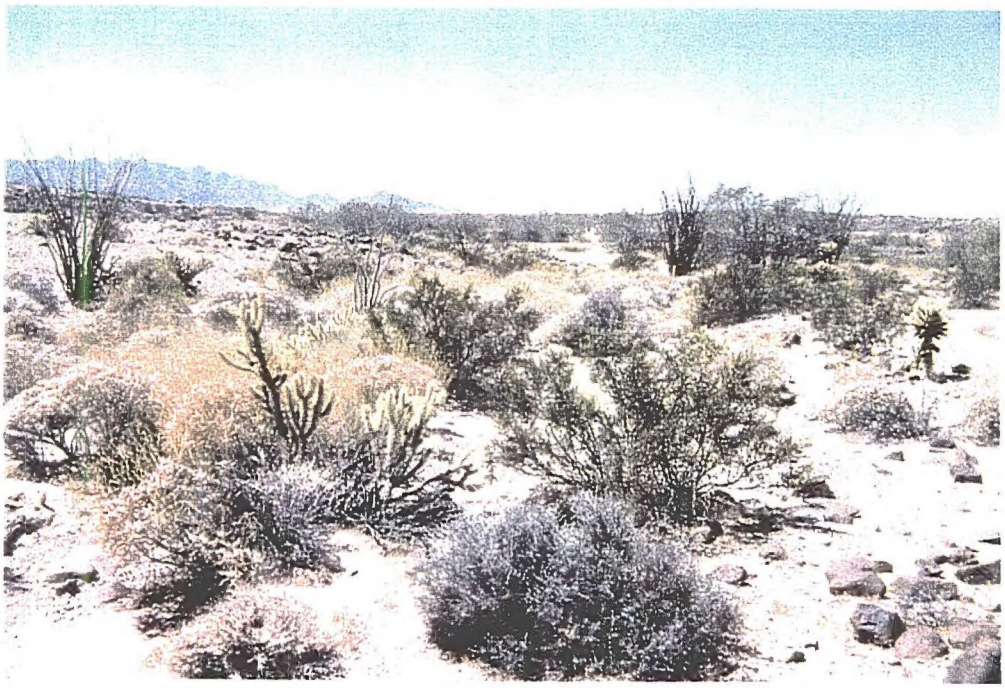


Figure 4-5 A shrub community in a shallow wash showing good vegetative cover, Imperial Project, June 1995

- The shallow subsidiary wash vegetation is similar to that in the major washes, and is equally as diverse and abundant including most of the upland species on the edges (see Figure 4-5). The washes are narrower (average 30 feet) and not as deep or broad, and have some finer soils washed or deposited in them. There are fewer and smaller trees. *Pleuraphis rigida* (big galleta), *Asclepias subulata* (ajameta-milkweed), *Calliandra eriophylla* (fairy duster), and *Hibiscus denudatus* (rose mallow) are additional species present. Slopes above and sides of these shallow washes support widely spaced barrel cactus. Vegetative cover is irregular on the bottoms and sides, and averaged from 35 to 45% during this year of excellent growth.

4.3 Plant Species Present

A list of the plant species found on the Imperial project site is given in Table A-1, Appendix A (nomenclature according to The Jepson Manual: Higher Plants of California, 1993, James C. Hickman, editor, University of California Press, Berkeley and Los Angles, California). The floristics of this area is typical for the southern hot (subtropical) California desert region. This is a low desert region with few frosts. There was a total of 112 plant species observed on the project site. There were no unusual plant assemblages or sensitive plant species present. There were several cactus species observed, and some species were fairly abundant such as *Opuntia bigelovii* (teddy-bear cactus). There are a few introduced species of plants, mainly grasses and mustards such as *Bromus tectorum* (downy chess) and *Brassica tournefortii* (mustard), that have become naturalized in the flora of the deserts.

4.4 Results of Quantitative Vegetation Surveys

The results of the survey are presented in the following sections. Total vegetative cover was abnormally high this year due to the abundant moisture this growing season and the three previous years. The identification and location of the transects are given in Table 4-1. We varied the size of the plots between transects to reflect the lower density of plants in some locations. The size was adjusted in order to obtain an adequate sample count.

4.4.1 Vegetative and Ground Cover

The results of the vegetative cover monitoring are presented in Table 4-2. The majority of perennial cover is by shrubs. The average total cover for all vegetation measured in the

Table 4-1 Identification and Locations for Vegetation Surveys for Imperial Project, June 1995						
Transect No.	Survey Date	Size (in meters)			No. of plots	Location
		width	length	total (m^2)		
NW-1	6/2/95	2	30	60	12	Northwest - wash in flats (1% grade)
NW-2	6/2/95	2	30	60	10	Northwest - wash in flats (1% grade)
NC-1	6/3/95	2	30	60	10	North Central - flats between drainages
NE-1	6/3/95	2	30	60	10	Northeast on slopes - upland pavement/float (dissected)
WC-2	6/2/95	2	30	60	10	West Central - upland slope
WC-1	6/2/95	2	10	20	12	West Central - shallow wash on upland
EC-1	6/3/95	2	10	20	10	East Central - along secondary entrenched wash - channel 20-25'; banks 15-25'
SE-1	6/3/95	4	30	120	10	Southeast - major broad wash on east side
NW-3	6/3/95	2	10	20	10	Northwest - main wash (deeply incised) - sandy bottom 35-40'; banks 25-35'

Table 4-2 Summary of Average Percent Ground Cover Results for Vegetation Transects, Imperial Project, June 1995.

Transect No.	Rock	Bare	Litter	Plant*	Trees & Shrubs	Herbaceous	
						Annual	Perennial
NW-1	68	22	3	7	1	6	1
NW-2	66	24	4	7	1	5	1
NC-1	61	27	3	9	2	7	0
NE-1	69	21	3	7	3	3	3
WC-2	70	19	5	7	2	3	2
WC-1	8	40	14	38	33	10	2
EC-1	10	28	21	42	35	15	2
SE-1	29	30	8	34	33	10	0
NW-3	6	17	12	66	63	14	1

* Plant cover does not include canopy overlap.

transects varied from 7% to 66%. This wide variation was dependant on the location of the transects; uniform vegetation cover on the upland flats and slopes averaged about 7% for 5 transects, and cover associated with washes averaged 45%. There was abundant winter rains late in the season, and cover and productivity by annual species was moderate this year at 8% cover in the transects. This amount of vegetative cover represents a maximum for this type of vegetation in this desert location due to excellent growing conditions this season. Rock, bare ground, and litter also varied widely depending on the location and soil cover.

4.4.2 Perennial Plant Diversity and Density

Perennial plant diversity and densities is presented in Table 4-3. The highest number of perennial plant species per transect was 10 and the lowest was 5. The average number of perennial plant species was 7.6 per transect. This is a medium to low diversity for desert vegetation and is typical for this lower desert region. This desert with extremely low rainfall requires highly adapted plant species, especially for perennial species. The wide spacing of plants allows for maximum water availability for individuals. The large size of our plots

maximized the diversity index.

Table 4-3 Summary of Shrub Density and Diversity Results, Imperial Project, June 1995.

Transect No.	Shrub density		Shrub diversity
	shrubs/hectare	shrubs/acre	
NW-1	167	67	6
NW-2	367	147	5
NC-1	333	133	6
NE-1	383	153	6
WC-2	450	180	7
WC-1	6,167	2,467	8
EC-1	2,200	880	10
SE-1	567	227	10
NW-3	1,650	660	10

The density of shrubs and trees was widely variable depending on the location of the transect (see Table 4-3). The lowest density of shrubs was in upland shrub scrub vegetation type at 67 plants per acre (167 plants per hectare), and the highest was in the shallow washes at 2,467 plants per acre (6,167 plants per hectare). The average shrub density measure in the transects over the entire project site was 546 per acre (1,365 per hectare). However, the higher densities (average 1,058 per acre) were only in less than 4% of the project site area, and the lower densities (average 136 per acre) were in the remaining 96% area. An adjusted density based on averages in the two vegetation types calculates to 173 plants per acre (432 plants per hectare).

The most common shrubs as indicated by the densities (Table 4-4) are in order of abundance *Encelia farinosa* (inciensio), *Ambrosia dumosa* (burrobush), *Larrea tridentata* (creosote bush), and the cactus *Opuntia bigelovii* (teddy-bear cholla). The two common tree species, *Olneya tesota* (desert ironwood) and *Cercidium floridum* (palo verde), are mostly confined to washes

Table 4-4 Perennial Species Count in Transects, Imperial Project, June 1995.

Plant Species	Transect No.								
	WC-1	WC-2	NW-1	NW-2	NW-3	NC-1	NE-1	EC-1	SE-1
Trees and Tall Shrubs									
Cercidium floridum	0	0	0	0	0	0	0	0	2
Olneya tesota	0	0	1	0	1	0	0	1	2
Shrubs									
Acacia greggii	0	0	0	0	3	0	0	0	0
Ambrosia dumosa	39	6	2	10	2	2	3	5	3
Bebbia juncea	0	0	0	0	3	0	0	2	14
Calliandra eriophylla	18	0	0	0	0	0	0	2	0
Encelia farinosa	54	6	1	4	12	3	1	8	23
Fouquieria splendens	1	1	0	0	0	1	1	0	0
Hibiscus denudatus	5	0	0	0	1	0	0	0	0
Hyptis emoryi	0	0	0	0	2	0	0	2	4
Krascheninnikovia lanata	0	0	0	0	0	0	0	4	0
Larrea tridentata	9	4	1	4	4	1	4	7	4
Lycium andersonii	0	0	0	0	4	0	0	7	11
Stephanomeria pauciflora	0	0	1	0	1	0	0	0	3
Grasses									
Pleuraphis rigida	15	0	0	0	0	0	0	6	0
Cactus									
Ferocactus cylindraceus	0	0	0	0	0	0	1	0	0
Opuntia basilaris	0	3	0	0	0	2	0	0	2
Opuntia bigelovii	0	5	6	3	0	11	13	0	0
Opuntia echinocarpa	7	2	0	1	0	0	0	0	0

at relatively low densities.

4.2.3 Plant species of concern

There are four plant species of concern or sensitive species under review potentially occurring at the proposed site:

- *Escobaria vivipara* var. *alversonii* (foxtail cactus)
- *Opuntia munzii* (Munz's cholla)
- *Salvia greatei* (orocopia sage)
- *Palafoxia arida* var. *gigantea* (giant spanish needle)

These species are all Federal Candidate (C2) species, species that need more study. The potential habitats for these species is toward the north and west of the project site. The proposed project site was surveyed for the species by walking transects in likely areas, and in the site in general. None of these species were observed and there is no evidence that they occur within the proposed project site.

5.0 SUMMARY AND DISCUSSION

The biological resources within the Imperial Project are typical for the lower, hot climate of this Sonora Desert region in southeastern California. The vegetation of the Imperial Project site is a typical desert creosote bush shrub scrub. There were two general types present: a shrub/scrub vegetation dominated by widely spaced shrub plants on alluvial flats and slopes; and tree/shrub vegetation with small trees and a greater diversity of shrubs associated with the washes and drainages. The shrub/scrub vegetation type covered 96% of the study area within the project boundaries. Topographic and soil differences occur over the study area and this was reflected in the varied heterogeneous vegetation types and patterns on the project site.

The dominant shrubs are *Encelia farinosa* (inciensio), *Ambrosia dumosa* (burrobush), *Larrea tridentata* (creosote bush), and the cactus *Opuntia bigelovii* (teddy-bear cholla). The two common tree species, *Olneya tesota* (desert ironwood) and *Cercidium floridum* (palo verde), are mostly confined to wash areas at relatively low densities. Perennial shrubs are the dominant vegetation, with trees and a few herbaceous perennials present on the sides and

islands of the washes. There were abundant winter rains late in the season, and cover and productivity by annual species was moderate this year at 8% cover in the transects. There are no sensitive habitats, assemblages of plants, or sensitive or endangered species present.

The average cover measured this season was 7% total plant cover in the shrub/scrub, and 45% cover in the tree/shrub wash vegetation. This vegetative cover was extremely high due to the excellent weather conditions this growing season, and represents a maximum to be expected in this desert location. Diversity (number of species) averaged 7.6 per transect, a medium to low diversity indicating the low number of perennial species and wide spacing of individual plants. Density of shrubs in shrub/scrub vegetation type was 67 plants per acre (167 plants per hectare), and the highest was in the shallow washes at 2,467 plants per acre (6,167 plants per hectare). The higher densities (average 1,058 per acre) were only in less than 4% of the project site area, and the lower densities (average 136 per acre) were in the remaining 96% area. An adjusted density based on averages in the two vegetation types calculates to 173 plants per acre (432 plants per hectare).

Reclamation of the area can be accomplished using methods we are presently using and testing at the nearby gold mining project near Picacho Peak and in the Cargo Muchacho Mountains. These methods include recontouring for moisture enhancement, no irrigation, and revegetation using native plant species from seed. Most of the larger washes in the central portion of the project site will not be disturbed during mine development. Plant specimens can be salvaged during mine construction, and include species of cactus and *Fouquieria splendens* (ocotilla). These plants can be marked prior to start of construction, and relocated to appropriate sites.

APPENDIX A

Table A-1 List of Plant Species at Imperial Project, June 1995.	
Scientific Name	Common Name
Trees and Tall Shrubs	
Cercidium floridum	palo verde
Olneya tesota	desert ironwood
Phoradendron californicum	mistletoe (parasitic on trees)
Prosopis velutina	mesquite
Shrubs	
Acacia greggii	catsclaw
Ambrosia dumosa	burrobush
Asclepias subulata	milkweed
Bebbia juncea	sweetbush
Calliandra eriophylla	fairy duster
Ditaxis lanceolata	lance-leaved ditaxis
Ditaxis neomexicana	ditaxis
Encelia farinosa	inciensio
Fouquieria splendens	ocotillo
Hibiscus denudatus	rose mallow
Hymenoclea salsola	cheesebush
Hyptis emoryi	desert lavender
Krameria erecta	purple heather
Krameria grayi	desert ratany
Krascheninnikovia lanata	winterfat
Larrea tridentata	creosote bush
Lycium andersonii	box thorn
Nicotiana obtusifolia	tobacco
Porophyllum gracile	odora

Table A-1 List of Plant Species at Imperial Project, June 1995.	
Scientific Name	Common Name
Psorothamnus schottii	indigo bush
Simmondsia chinensis	jojoba
Stephanomeria pauciflora	wire lettuce
Grasses	
Achnatherum speciosum	desert needlegrass
Aristida purpurea	triple-awned grass
Bromus madritensis	red brome
Bromus tectorum	downy chess
Cynodon dactylon	bermuda grass
Erioneuron pulchellum	fluff grass
Muhlenbergia porteri	muhly
Pleuraphis rigida	big galleta grass
Schismus barbatus	mediterranean grass
Herbs	
Allionia incarnata	windmill
Amsinckia tessellata	fiddleneck
Asclepias subulata	ajamete
Atrichoseris platyphylla	gravel-ghost
Brassica tournefortii	mustard
Calycoseris wrightii	yellow tack-stem
Camissonia boothii	booth's evening primrose
Camissonia brevipes	evening primrose
Camissonia claviformis	club evening primrose
Camissonia refracta	narrow-leaved primrose
Chaenactis carphoclinia	pebble pincushion
Chaenactis stevioides	chaenactis

Table A-1 List of Plant Species at Imperial Project, June 1995.	
Scientific Name	Common Name
Chamaesyce albomarginata	white-fringed sandmat
Chamaesyce polycarpa	prostrate spurge
Chenopodium sp.	pigweed
Chorizanthe brevicornu	brittle spine-flower
Chorizanthe corrugata	corrugata
Chorizanthe rigida	spiny chorizanthe
Cryptantha angustifolia	narrowleaved forget-me-not
Cryptantha barbigera	bearded forget-me-not
Cryptantha circumscissa	western forget-me-not
Cryptantha dumetorum	flexuous forget-me-not
Cryptantha holoptera	winged cryptantha
Cryptantha maritima	white-haired forget-me-not
Cryptantha micrantha	Nevada forget-me-not
Cryptantha nevadensis	Nevada forget-me-not
Cucurbita palmata	coyote melon
Dalea mollissima	indigobush
Descuriana pinnata	yellow tansy mustard
Eremalche rotundifolia	desert five-spot
Eriastrum diffusum	eriastrum
Eriogonum inflatum	desert trumpet
Eriogonum pusillum	yellow turbin
Eriogonum thomasii	thomas buckwheat
Erodium texanum	desert heron's bill
Eschscholtzia minutiflora	little gold poppy
Euphorbia eriantha	beetle spurge
Fagonia laevis	smooth-stemmed fagonia

Table A-1 List of Plant Species at Imperial Project, June 1995.	
Scientific Name	Common Name
Geraea canescens	desert sunflower
Gilia spp.	gilia
Gilia latifolia	gilia
Guillenia lasiophylla	california mustard
Gutierrezia microcephala	sticky snakeweed
Hesperocallis undulata	desert lily
Horsfordia newberryi	yellow felt-plant
Langloisia setosissima	langloisia
Lepidium lasiocarpum	peppergrass
Loeseliastrum schottii	calico
Lotus strigosus	lotus
Mentzelia albicaulis	small-flowered blazing star
Mentzelia involucrata	sand blazing star
Mohavea confertifolia	ghost flower
Mirabilis bigelovii	four o'clock
Monoptilon bellioides	desert star
Nama demissum	purple mat
Nemacladus glanduliferus	thread plant
Nemacladus rubescens	rigid-stemmed thread plant
Oligomeris linifolia	linear-leaved cambess
Pectocarya platycarpa	broad-nutted comb-bur
Perityle emoryi	rock daisy
Phacelia crenulata	notch-leaved phacelia
Phacelia distans	fern phacelia
Phacelia fremontii	fremont phacelia
Plantago ovata	plantain

Table A-1 List of Plant Species at Imperial Project, June 1995.	
Scientific Name	Common Name
Psathyrotes ramosissima	turtleback
Salsola tragus	russian thistle
Salvia columbariae	chia
Sarcostemma cyanchoides	climbling milkweed
Streptanthella longirostris	small jewelflower
Tiquilia canescens	tiquilia
Trichoptilium incisum	yellow-head
Trixis californica	trixis
Uropappus lindleyi	silver puffs
Cactus	
Echinocactus polycephalus	cotton-top cactus
Ferocactus cylindraceus	barrel cactus
Mammilaria tetrancistra	nipple or fishhook cactus
Opuntia acanthocarpa	buckhorn cholla
Opuntia echinocarpa	golden cholla
Opuntia basilaris	beavertail cactus
Opuntia bigelovii	teddy-bear cholla
Opuntia ramosissima	pencil cactus

(Nomenclature according to The Jepson Manual, 1993)

Adapted from a list of plant species by Ted Rado, Consulting Biologist, Riverside.

APPENDIX G - BIOLOGICAL SURVEY REPORT, CHEMGOLD IMPERIAL PROJECT, CALIFORNIA

BIOLOGICAL SURVEY REPORT

CHEMGOLD IMPERIAL PROJECT, IMPERIAL COUNTY, CALIFORNIA

Prepared for:

ENVIRONMENTAL MANAGEMENT ASSOCIATES
405 South State College Boulevard, Suite 211
Brea, California 92621

Submitted to:

U.S. BUREAU OF LAND MANAGEMENT
El Centro Resource Area Office
1661 South 4th Street
El Centro, California 92243

Prepared by:

TED RADO
3144 Celeste Drive
Riverside, California 92507

MAY 1995

TABLE OF CONTENTS

Section		Page
	SUMMARY	iii
1.0	INTRODUCTION	1
	A. Objective	1
	B. Relationship to Regional Plans	1
	C. Regulatory Framework	2
	D. Species of Special Concern	2
2.0	DESCRIPTION OF THE PROPOSED ACTION	7
3.0	DESCRIPTION OF THE AFFECTED ENVIRONMENT	11
	A. General Description	11
	B. Biology of Listed Species	14
	C. Survey Methods	18
	D. Survey Results	21
4.0	CONCLUSION	27
5.0	LITERATURE CITED	27
	APPENDIX	32

SUMMARY

Chemgold, Incorporated, proposes to operate a large-scale open pit mining operation north of the Cargo Muchacho Mountains in southeastern Imperial County. Systematic surveys of this project site and associated access road/utility line corridor were conducted between July and September 1994, and February and May 1995. Surveys documented the occurrence of the federally and State listed threatened desert tortoise. Although not present on the project site, commute traffic along the southern one mile of Olgilby Road may also affect the proposed threatened flat-tailed horned lizard.

A single observation of the State endangered gila woodpecker was also made in January 1995 during these site surveys. Followup surveys for additional breeding and nesting woodpeckers during the spring did not result in further gila woodpecker observations. This single observation is believed to represent a transient bird. Favorable gila woodpecker habitats are not present on the project site.

Additional species of sensitive plants and wildlife recorded during the project surveys included the Federal candidate chuckwalla, and California Species of Special concern sharp-shinned hawk, northern harrier and American badger. Two sensitive plant species, fairy duster and winged forget-me-not, were recorded from the project site.

No sources of perennial surface water, riparian habitats, wetland habitats or otherwise rare or unique habitats are present on the project site. Several washes crossing the site contain a low to dense tree assemblage dominated by ironwood and palo verde that is utilized by several game species, including mourning dove, Gambel's quail, desert cottontail, and deer.

1.0 INTRODUCTION

A. Objective

This biological survey report was prepared to summarize results of surveys for wildlife and plants that can be used during preparation of a subsequent biological assessment addressing the effects to listed and sensitive wildlife and plant species associated with a proposed large-scale mining operation in southeastern Imperial County. The objective of this survey and report was to identify the presence and distribution of listed and sensitive species of wildlife and plants, as determined through field inspection, database review and literature sources.

Collection of this information was made utilizing two principal methods: (1) a review of the existing database from the area, as determined through literature sources, agency records, and the California Natural Diversity Database (CNDDB); and (2) systematic site surveys of the project site, including the access route and utility corridors, for such species. Information sources used in part to prepare this biological survey report included a review of the California Natural Diversity Database (CNDDB) records for the following USGS quadrangles: Hedges and Olgilby. This basic information was supplemented with review of species-specific information sources on biology and distribution (Berry et al. 1984; Turner et al. 1980a, 1980b; CNPS 1994; Hall 1981), from agency documents (USBLM 1980; USFWS 1994a, 1994b) and from review of environmental documents addressing similar mining projects in the general vicinity (Environmental Solutions 1987; Condor Minerals Management 1991a, 1991b; DeDycker and Associates 1994).

B. Relationship to Regional Plans

The entire project area lies within the California Desert Conservation Area (CDCA), an approximately 25 million-acre area designated and managed largely under the guidance of the U.S. Bureau of Land Management (BLM). The attending regional plan for the CDCA provides guidance governing land uses and legislated mandates within this area (BLM 1980). The project area is within designated Class L (Limited Use) lands identified in the CDCA plan. Development within Class L lands is allowed subject to controls imposed by the USBLM.

The project also lies within the boundary of the Northern and Eastern Colorado Desert Coordinated Management Area. The U.S. Bureau of Land Management is developing a long-term regional management plan for this area. The plan will address a broad spectrum of land uses that include mineral exploration and development as well as protection of biological resources. No draft planning documents have been prepared to date.

The project area is also within the boundary of the Eastern Colorado Recovery Unit for the desert tortoise. Recovery planning for this species within the Eastern Colorado Recovery Unit specifies the creation of a 750-950 square mile reserve "centered" on the Chuckwalla Bench (USFWS 1994b). This reserve area lies to the north and northwest of the proposed mining project site.

The proposed mining site is not within any designated Area of Critical Environmental Concern (USBLM 1980), and lies outside of any recently designated wilderness areas.

C. Regulatory Framework

Pertinent State and Federal regulations governing a review of the proposed mining project for listed and sensitive species are the Federal Endangered Species Act of 1973, as amended, and the California Endangered Species Act of 1984. The Federal Endangered Species Act of 1973, as amended, prohibits the "take" (killing, harming or harassment) of federally listed species without special exemption. Section 7(a) of the Act allows for a Federal agency involved with permitting, funding or otherwise authorizing a project to formally consult with the U.S. Fish and Wildlife Service on any action that may adversely affect a listed species.

The California Endangered Species Act of 1984 also prohibits the "take" of any State listed species. A State "lead" agency is required to consult with the California Department of Fish and Game for any projects affecting State listed species. For non-State agencies, authorization for such take is available through an Endangered Species Management Permit under Section 2081 of the Fish and Game Code, that establishes measures for the protection of the affected species and its habitat during project actions.

D. Species of Special Management Concern

Listed and Federal candidate species that are known to occur in the general vicinity of the proposed mining project site are provided in Table 1.

Table 1. Candidate and Listed Species of Wildlife and Plants Known to Occur in the General Vicinity of the Proposed Mining Project

Common/Scientific Name	Status*
Plants	
Pierson's milk-vetch (*Astragalus magdalena* var. *Piersonii*)	CNPS1B/ PE/SE**
Borrego milk-vetch (*Astragalus lentiginosus* var. *borreganus*)	SP/CNPS4

Table 1. Continued

Common/Scientific Name	Status**
ribbed cryptantha (Cryptantha costata)	SP/CNPS 4
winged cryptantha (Cryptantha holoptera)	SP/CNPS 4
fairy duster (Calliandra eriophylla)	SP/CNPS 2
rock nettle (Eucnide rupestris)	SP/CNPS 2
hairy stickleaf (Mentzelia hirsutissima)	C3c/SP/ CNPS 2
slender-lobed four o'clock (Mirabilis tenuiloba)	SP/4
Wiggin's cholla (Opuntia wigginsii)	CNPS 3/ SP/C2
foxtail cactus (Escobaria vivipara var. alversonii)	CNPS1B/ SP/C2
Algodones Dunes sunflower (Helianthus niveus ssp. tephrodes)	CNPS 1B/ SP/C2**
Munz's cholla (Opuntia munzii)	CNPS 1B/ SP/C2**
giant spanish needle (Palafoxia arida var. gigantea)	CNPS 1B/ SP/C2**
Orocopia sage (Salvia greatei)	CNPS 1B/ C2/SP
Wiggin's croton (Croton wigginsii)	SP/CNPS 3/ C3c**
Wildlife	
alkali skipper (Pseudocopaedes eunus eunus)	C2
cheeseweed owlfly (Oliarces clara)	C2

Table 1. Continued

Common/Scientific Name	Status**
Andrew's dune scarab beetle (Pseudocotalpa andrewsi)	C2**
brown-tassel trigonoscuta weevil (Trigonoscuta brunnotasselata)	C2
desert pupfish (Cyprinodon macularis)	FE/SE**
razorback sucker (Xyrauchen texanus)	FE/SE**
flannelmouth sucker (Catastomus latipinnis)	C2**
roundtail chub (Gila robusta)	C2**
Arizona southwestern toad (Bufo m. microscaphus)	C2/CSC**
Yavapai leopard frog (Rana yavapaiensis)	C2**
Couche's spadefoot toad (Scaphiopus couchi)	CSC*8
desert tortoise (Gopherus agassizii)	FT/ST
flat-tailed horned lizard (Phrynosoma mcallii)	FPT/CSC**
chuckwalla (Sauromalus obesus)	C2
Colorado Desert fringe-toed lizard (Uma n. notata)	C2/CSC**
bald eagle (Haliaeetus leucocephalus)	SE/FE**
brown pelican (Pelecanus occidentalis)	FT/ST**
Peregrine falcon (Falco peregrinus)	FE/SE**

Table 1. Continued

Common/Scientific Name	Status**
Yuma clapper rail (Rallus longirostris yumanensis)	FE/SE**
Aleutian Canada goose (Branta canadensis leucopareia)	FT/ST**
southwestern willow flycatcher (Empidonax traillii extimus)	PFE/SE**
black rail (Laterallus jamaicensis coturniculus)	C2/ST**
black tern (Chilodonias niger)	C2**
burrowing owl (Athene cunicularia)	C2/CSC
LeConte's thrasher (Toxostoma lecontei)	CSC
ferruginous hawk (Buteo regalis)	C2/CSC
northern harrier (Circus cyaneus)	CSC
large-billed savannah sparrow (Passerculus sanwichensis rostratus)	C2/CSC**
loggerhead shrike (Lanius ludovicianus)	CSC
gila woodpecker (Melanerpes uropygialis)	SE/C2
mountain plover (Charadrius montanus)	C2**
western least bittern (Ixobrychus exilis hesperus)	C2**
white-faced ibis (Plegadis chihi)	C2**
California leaf-nosed bat (Macrotis californicus)	C2/CSC

Table 1. Continued

Common/Scientific Name	Status**
greater western mastiff bat (Eumops perotis californicus)	C2/CSC
Occult little brown bat (Myotis lucifugus occultus)	C2/CSC
Southwestern cave myotis (Myotis velifer brevis)	C2/CSC
spotted bat (Euderma maculatum)	C2/CSC
Yuma hispid cotton rat (Sigmodon hispidus eremicus)	C2/CSC**
white-throated woodrat (Neotoma albigula venusta)	CSC
Yuma puma (Felis concolor browni)	C2/CSC
Colorado River cotton rat (Sigmodon arizonae plenus)	C2/CSC**
American badger (Taxidea taxus)	CSC***

*FE=federally listed as endangered;
FPE=federally proposed for endangered status
FT=federally listed as threatened;
FPT=federally proposed for threatened status
SE=State listed as endangered;
ST=State listed as threatened;
C1=Federal Category 1 candidate species (sufficient information to warrant a listing proposal);
C2=Category 2 candidate species (more information on status needed);
C3c=Category 3 candidate species (too widespread-not threatened at present time)
SP=California special plant;
CSC=California species of concern
CNPS 1B=taxa determined by the California Native Plant Society to be rare, threatened and endangered; CNPS 2=species rare or endangered in California but common elsewhere; CNPS 3=more information on status needed; CNPS 4=species of limited distribution

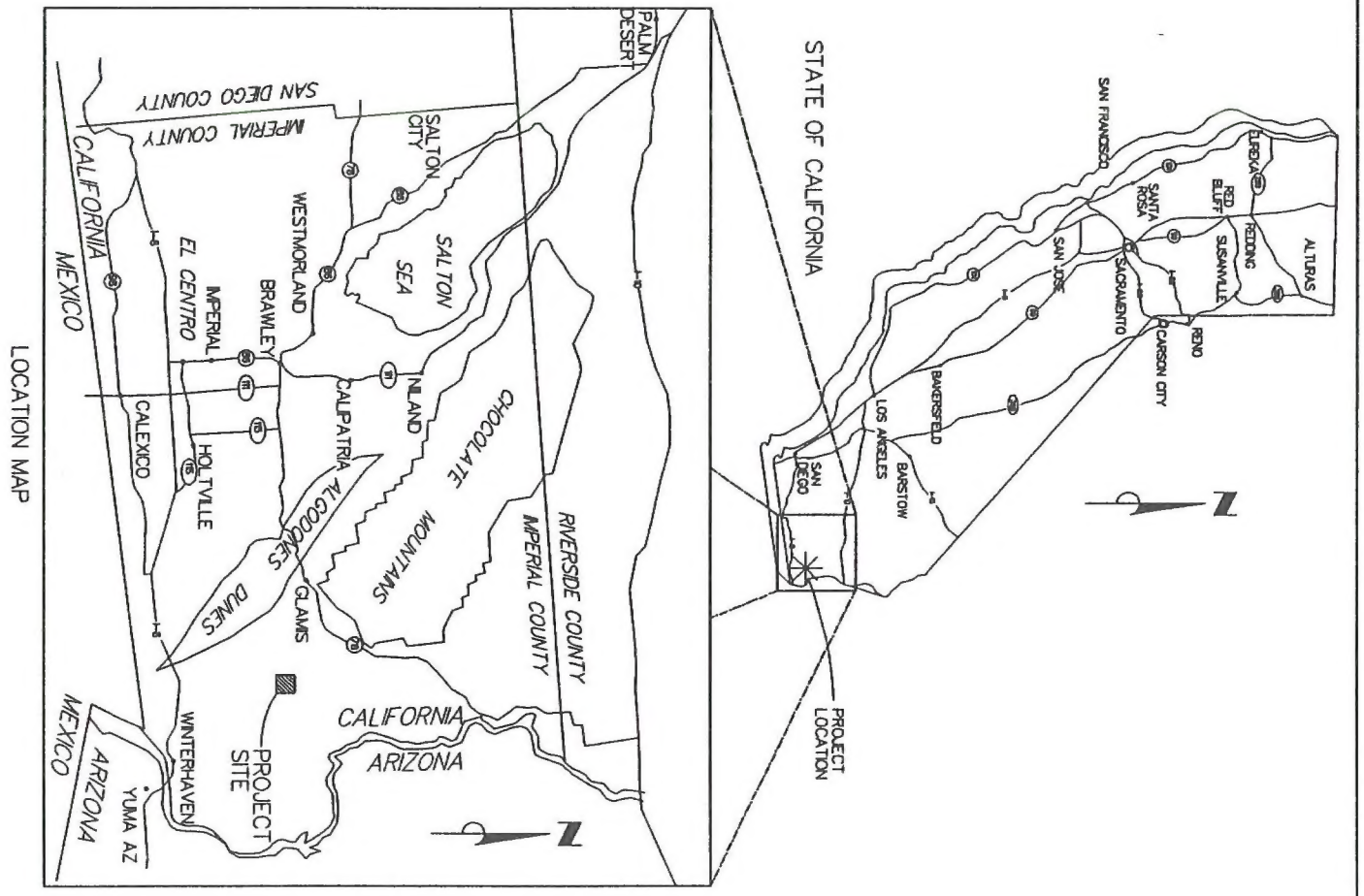
**No potential habitats for species present on project site

2.0 PROJECT DESCRIPTION

Chemgold, Incorporated, plans to develop gold-bearing deposits within a 1,576-acre area north of the Cargo Muchacho Mountains. This project, designated as the "Imperial Project" by the company, lies approximately twelve miles north of Interstate Highway 8 and 15 miles northwest of Yuma (Figure 1). The project would entail the extraction of gold ore from up to three sites, possible crushing of ore to appropriate size, placement of ore on heap leach pads and separation of gold using a cyanide solution. Overburden would be removed and deposited in the south and southwestern portions of the site. Electrical power would be provided by utility lines connecting to an existing 161 kilovolt corridor 4.5 miles west of the project site. Water for this operation would either be provided on-site from development of water wells or imported via a constructed underground pipeline travelling along Indian Pass Road from the well field road (Figure 2). Associated project facilities would include an administration area, with office buildings; a maintenance yard and parking/storage and equipment laydown area; haul roads connecting the three ore pits to ore processing sites and to overburden deposition sites; and a perimeter security fence with an entrance station. In order to minimize any potential for flashflooding to occur across project sites during severe storms, a storm bypass or diversion channel will also be constructed. Project components are summarized in Table 2.

The Imperial Project will collectively encompass 1,576 acres and is expected to last approximately 10-20 years, depending upon extent of ore and other factors. In the initial stages of development, an ore pit will be excavated in the west-central portion of the project area. Operations involving the removal of ore and ore processing from this initial pit are expected to last approximately 4-8 years. As economically recoverable ore is removed from this pit, ore extraction operations will then shift to a second pit located in the east-central portion of the project area. Recovery of ore from this second pit is also expected to last about 4-8 years. Recovery from the third remaining pit is expected to last about 2-4 years. Following removal and processing of ore, the facilities and equipment shall be dismantled and/or removed, and implementation of a restoration program shall begin.

Proposed mining activities are expected to employee at total of 150 personnel during peak operations. Mining actions will operate continuously, on shifts staggered over a 24-hour day. Equipment associated with ore extraction and processing may include 8-10 haul trucks, 2-3 front-end loaders or shovels, 2-3 dozers, 2 drilling rigs, 2-3 water trucks, and various ancillary equipment. Equipment used for operations will be stored and maintained on the project site.



ENVIRONMENTAL MANAGEMENT ASSOCIATES

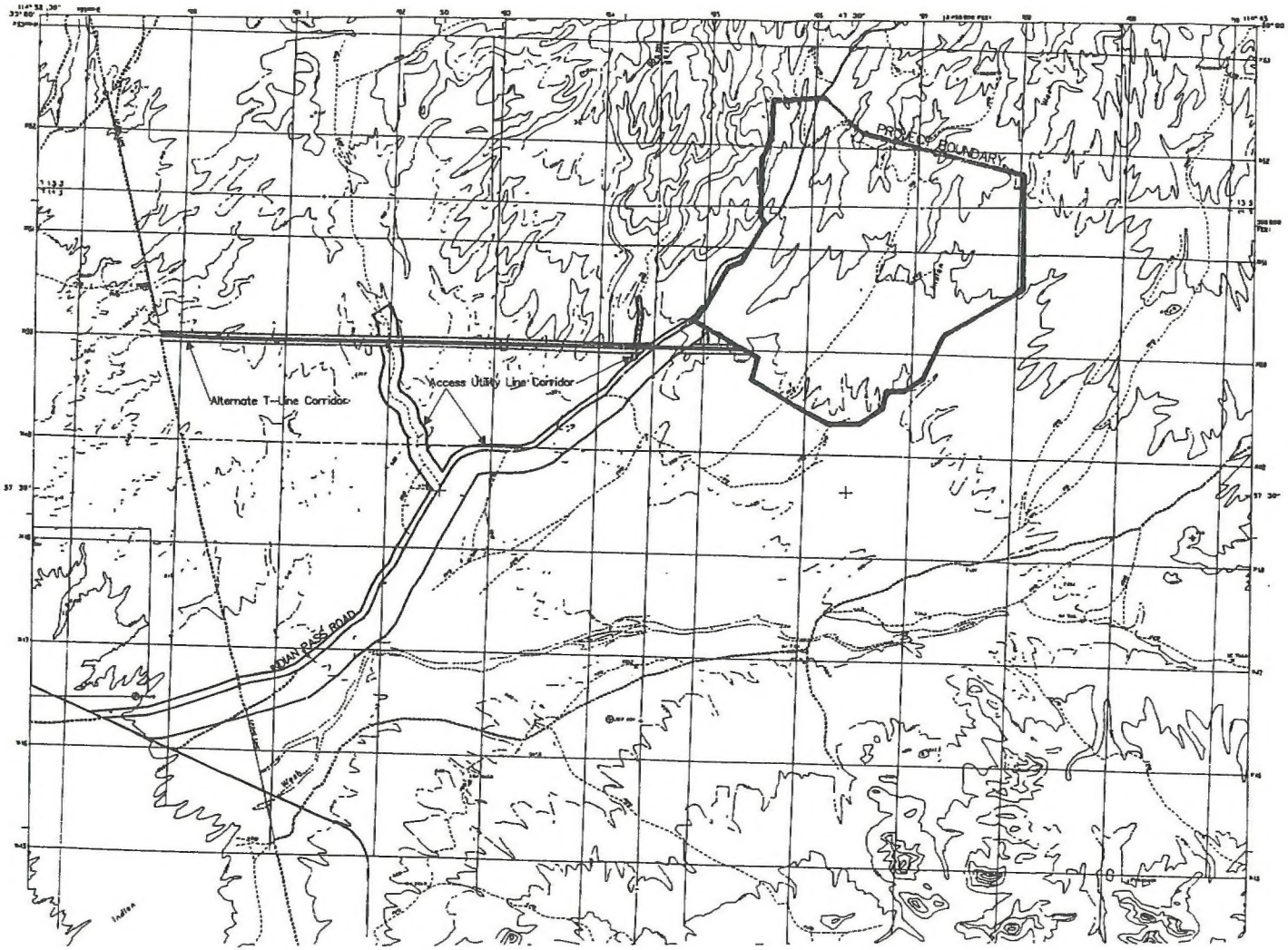
CORPORATE OFFICE:
405 S. State College Blvd., #211
Brea, California 92621
TEL (714) 529-3695
FAX (714) 529-8543

REGIONAL OFFICE:
100 West Grove Street, #100
Reno, Nevada 89509
TEL (702) 828-3939
FAX (702) 828-3940

DRAWN BY: LT
CHK'D: RFD
NO SCALE
DATE: 05/23/95
DRAWING NO. 1060-101

EXPLANATION

FIGURE 1: Imperial Project General Location Map



EMA

ENVIRONMENTAL MANAGEMENT ASSOCIATES, INC.

SCALE:

0 1 2

Miles

TITLE: FIGURE 2 – CHEMGOLD IMPERIAL PROJECT FACILITY, showing boundaries of the mine and process area, associated road/utility line corridor, and alternate transmission line corridor

Table 2. Components that Comprise the Imperial Project Site Layout*

Component	Estimated Acreage Covered
West Pit	127
East Pit	254
Singer Pit	36
Mineral Potential Area	96
Pads	378
Process Facility Area	24
Lime Bin Areas/Fresh Water Pond	3
Waste Rock Stockpiles:	
East	96
West	43
South	240
Topsoil Stockpiles	
West	8
North	28
South	29
Ancillary Facilities:	
Office/Maintenance/Parking	16
Roads:	
Haul and Maintenance	29
Drainage Diversions	9
County Road Realignment	7
Powerline/Pipeline/Water Wells	29
Total Proposed Surface Disturbance	**1,452**
Total Undisturbed Areas	**124**
Total Project Area	**1,576**

*Source: Environmental Management Associates

Current site access is via Olgilby Road, a secondary paved road, and Indian Pass Road, a County maintained dirt road. Hyduke Road (A278), connects with an unmaintained dirt road leading into the southeast corner of the project site. This road is proposed as an alternate storm access route. Employee traffic is expected to originate principally from Yuma, Arizona, and El Centro, California. One-way commute traffic to the Imperial Project site is about 30 miles. Under full development, an anticipated total of between 40-60 vehicles per day will commute to the project site.

In order to facilitate ore processing, a water source would be developed either on the project site or near the utility/access corridor (Indian Pass Road) leading to the site. Currently, Chemgold is investigating the potential of developing on-site groundwater resources. However, in the event that this approach proves infeasible, the company may pipe in water from outside the

project area. A corridor extending for 150 feet north and 500 feet south of Indian Pass Road and 300 feet east and west of either of two jeep trails trending north from Indian Pass Road has been identified within which well sites and a water pipeline may be located (Figure 2). Construction of this water pipeline would involve placement of pipe segments along the surface. An approximately
10-inch diameter pipe would be buried to an average depth of about five feet. Construction activities would result in the temporary disturbance to surface soils and vegetation within a corridor 50 feet in width and approximately two linear miles in length. Associated construction equipment would include trackhoes, backhoes, welding trucks, pipe trucks, sidebooms, water trucks, and pickup trucks.

Electrical power would be provided by a constructed above-ground utility line connecting to an existing 161-kilovolt line about four miles west of the project site. A primary and a secondary route have been identified (Figure 2). The primary route would closely parallel the water pipeline route, within a 500-foot-wide strip extending south from and paralleling Indian Pass Road, a linear distance of 4.5 miles. A secondary route would be used in the event that the primary route proves infeasible. This secondary transmission line route would originate at this existing 161 kilovolt line at a point 1.3 miles farther north, and then travel due east to the project site, a distance of about 3.5 linear miles. Construction activities would result in the temporary disturbance to surface soils and vegetation within a corridor 50 feet in width and up to about 4.5 miles in length. Associated construction equipment would include sidebooms, water trucks, and pickup trucks.

3.0 Environmental Setting

A. General Description

The Imperial Project is located in southeastern Imperial County, approximately 12 miles west of the Colorado River (Figure 1). The project encompasses portions of unsurveyed Townships 13 South, Ranges 20 and 21 East, and 14 South, Ranges 20 and 21 East, San Bernardino Baseline Meridian. This general area consists of a broad westerly-facing alluvial plain extending between the Cargo Muchacho Mountains to the southeast, and Peter Kane Mountain to the northeast. Topography is characterized by a series of gently rolling ridgelines parallelled by interconnecting drainages. The southeastern portion of the project site is nearly level. Topography becomes increasingly hilly to the north and the northwest. Elevation on the project site ranges from 760 feet near the south boundary to 925 feet on a prominent ridgeline along the northern boundary.

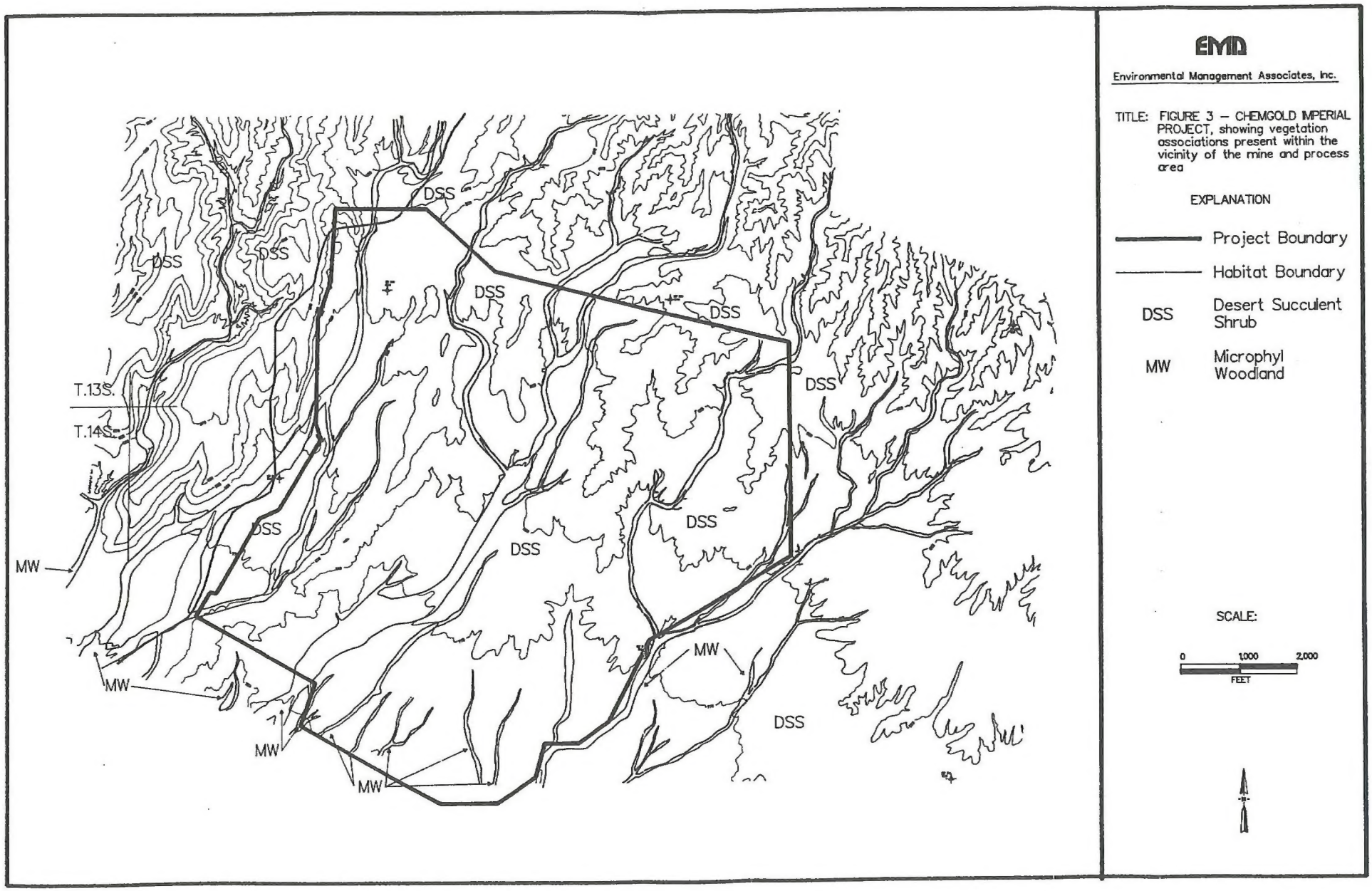
Soils in the project area are dominated by desert pavement, consisting of a basalt rock rubble field extending southwest from

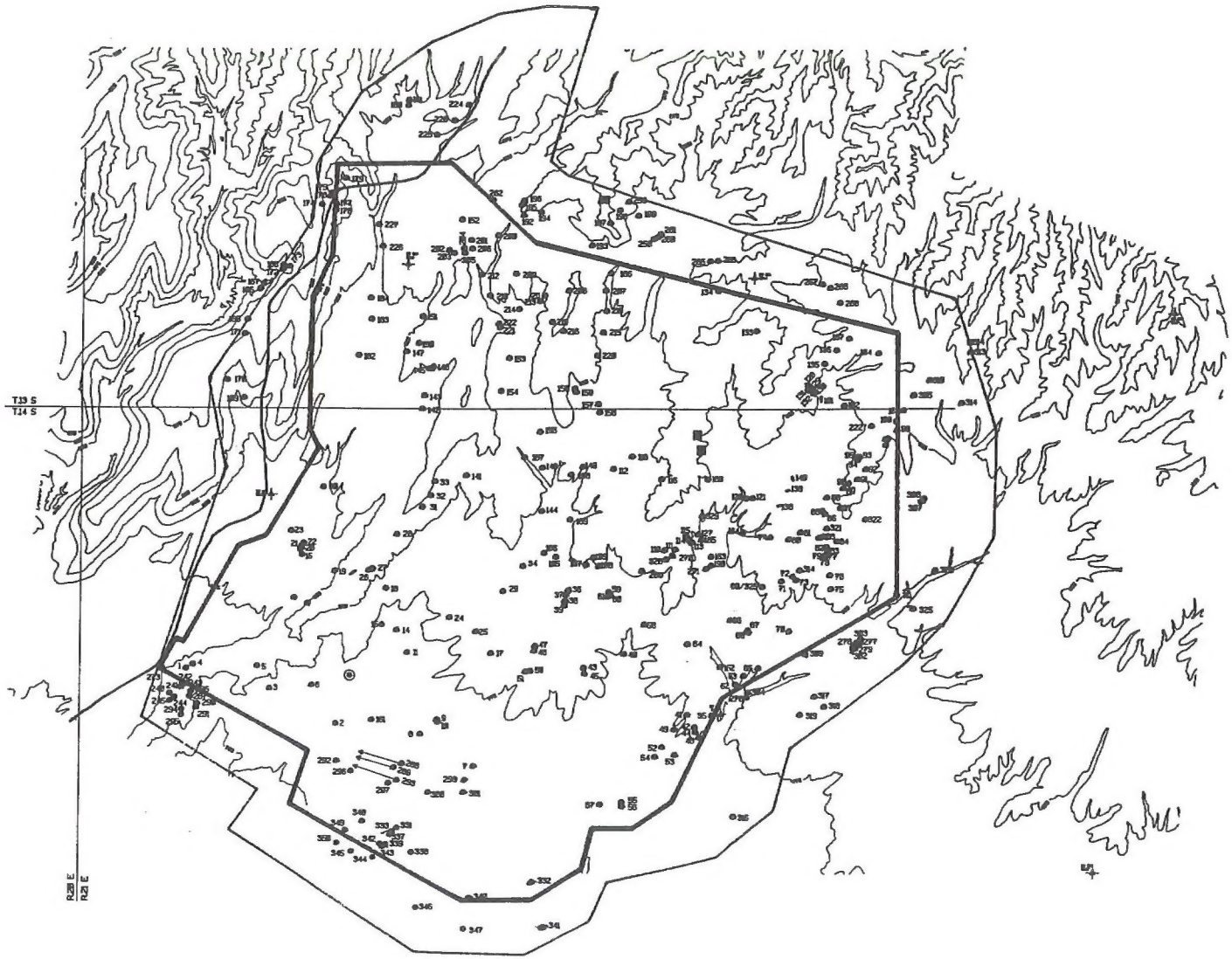
Peter Kane Mountain. A gravel-based alluvial soil is present in all major drainages, and over the west-central portion of the project site. Three primary washes and several secondary drainages are present. The largest wash, extending southwest along the base of a ridgeline at the western project boundary, parallels Indian Pass Road. Two smaller drainages also extend southwesterly from the central and eastern portions of the project site. These drainages consist of microphyll woodland habitat dominated by ironwood (*Olneya tesota*) and palo verde (*Cercidium floridum*), with a diverse plant association containing cat's-claw (*Acacia greggii*), purple heather (*Krameria erecta*), desert lavender (*Hyptis emoryi*), Anderson thornbush (*Lycium andersonii*) and yellow felt-plant (*Horsfordia newberryi*).

The remaining areas on the project site consist of desert succulent scrub habitat (Figure 3). Vegetation is typically sparsely distributed and "concentrated" at the bases of ridgelines and in "pockets" near small drainages. Dominant plants include creosote bush (*Larrea tridentata*), burrobush (*Ambrosia dumosa*), ocotillo (*Foaquieria splendens*), brittlebush (*Encelia farinosa*), and Bigelow cholla (*Opuntia bigelovii*). Although sparsely vegetated, several cactus species occur in this habitat, including Bigelow cholla, cottontop cactus (*Echinocactus polycephalus*), beavertail (Opuntia basalaris), diamond cactus (*Opuntia ramosissima*), and California barrel cactus (*Ferocactus cylindriceus*).

No sources of standing surface water, wetland habitats, or riparian habitats are present on or adjacent to the project site, associated access road corridor, or utility line corridor. Additionally, no aeolian sand deposits, including star dunes, sheet dunes, or wind-accumulated sand deposits are present.

Wildlife in the project area is characteristic of the Eastern Colorado Desert. Common reptiles include the zebra-tailed lizard (*Callisaurus draconoides*), side-blotched lizard (*Uta stansburiana*), western whiptial (*Cnemidophorus tigris*), and desert iguana (*Dipsosaurus dorsalis*). Microphyll woodland along larger washes is used by a variety of birds, that include mourning doves (*Zenaida macroura*), Gambel's quail (*Lophortyx gambelii*), Say's phoebes (*Sayornis saya*), and black-tailed gnatcatchers (*Polioptila melanura*). Birds frequenting desert succulent scrub habitat include the black-throated sparrow (*Amphispiza bilineata*), loggerhead shrike (*Lanius ludovicianus*), and cactus wren (*Campylorhynchus brunnecapillus*). Mammals include the antelope ground squirrel (*Ammospermophilus leucurus*), Merriam kangaroo rat (*Dipodomys merriami*), desert woodrat (*Neotoma lepida*) and black-tailed jackrabbit (*Lepus californicus*). Deer (*Odocoileus hemionus*)


DSS
DSS
DSS
DSS
DSS
DSS
DSS
DSS
DSS
DSS
T.13S.
T.14S.
MW
MW
MW
MW
MW
MW
DSS
EMA
Environmental Management Associates, Inc.
TITLE: FIGURE 3 – CHEMGOLD IMPERIAL PROJECT, showing vegetation associations present within the vicinity of the mine and process area
EXPLANATION
Project Boundary
Habitat Boundary
DSS Desert Succulent Shrub
MW Microphyl Woodland
SCALE:
0 1,000 2,000
FEET
N



EMA

Environmental Management Associates, Inc.

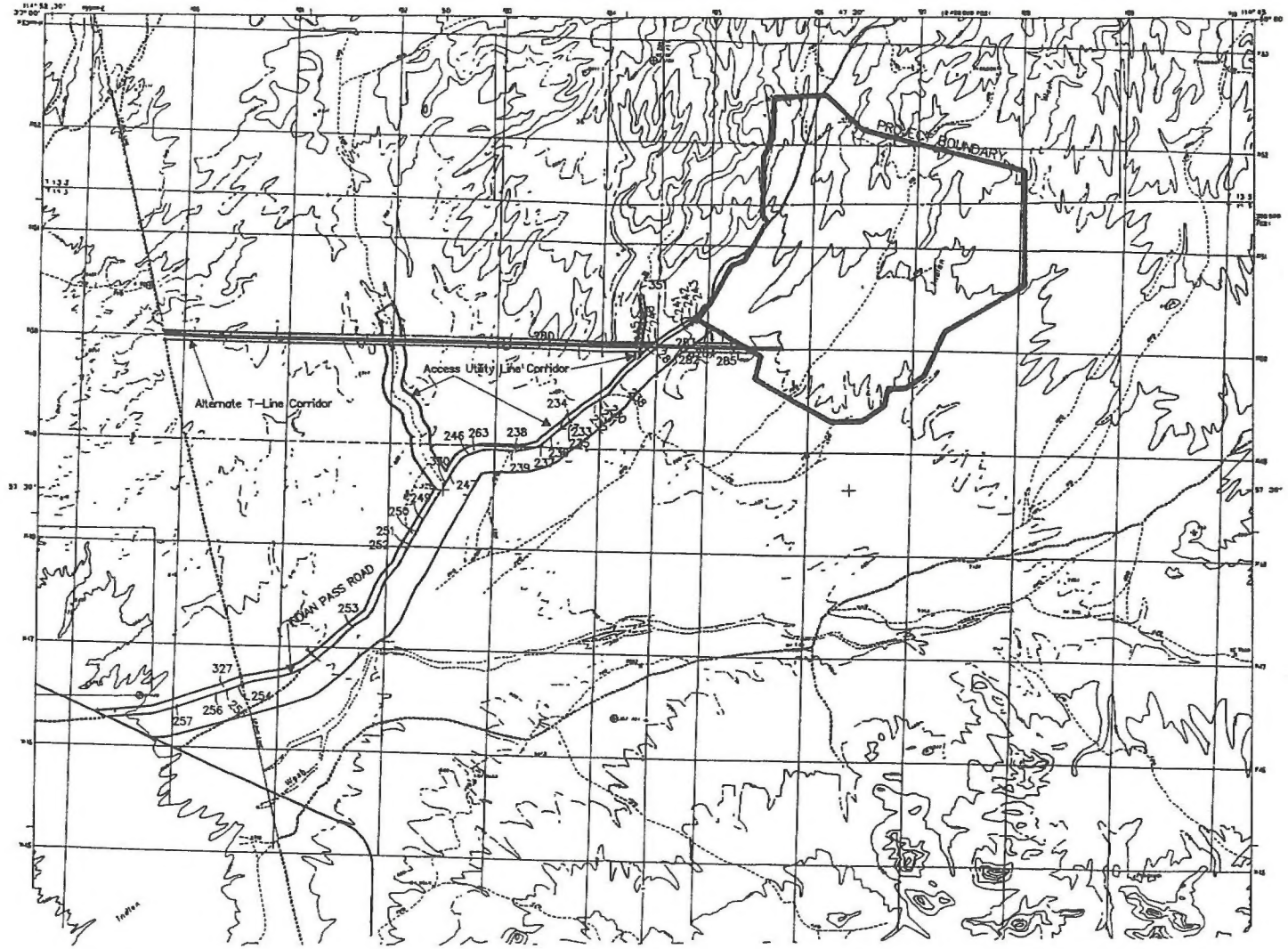
TITLE: FIGURE 4 - CHEMGOLD IMPERIAL PROJECT, showing results of transect surveys in the vicinity of the mine and process area (see Appendix C for specific data on map numbers)

EXPLANATION

- Project Boundary
- Survey Boundary
- •123 Desert Tortoise Sign
- Gila Woodpecker observation
- Chuckwalla observation

SCALE:

0 1000 2000
FEET



EMA

ENVIRONMENTAL MANAGEMENT ASSOCIATES, INC.

TITLE: FIGURE 5 -- CHEMGOLD IMPERIAL PROJECT, showing results of transect surveys conducted along road/utility line corridor (see Appendix C for specific data on map numbers)

SCALE:

0 1 2

Miles

also frequent washes throughout this area, and travel cross-country across more open desert lands between washes. Larger mammalian predators include the kit fox (*Vulpes macrotis*), coyote (*Canis latrans*), and American badger (*Taxidea taxa*).

Human-related uses within the site have included seasonal camping along the largest wash system, deer and game bird hunting, off-road vehicle "free-play", bombing and strafing by military aircraft, and small-scale mining. Camping use has been concentrated along the eastern embankment of a large wash parallelling Indian Pass Road. Use is scattered, confined to winter and spring months, and has resulted in the creation of fire rings, destruction of mature ironwood and palo verde trees for firewood, off-road vehicle use, and deposition of trash.

Hunting pressure within and surrounding the project area is also concentrated in larger washes. Spent sporting rifle cartridges and shotgun shells are present. Off highway vehicle use in most moderate-to-large washes is probably a result of both camping and hunting uses.

Evidence of old bombing and strafing by military aircraft, a result of practice during World War II, is evident over most of the project site. This evidence includes old .50 caliber machine gun shells and clip pieces, and small bomb craters with shrapnel fragments. More recent military use in the area includes numerous fly-bys by jet aircraft and touchdowns by helicopters.

The Imperial Project site has also been subject to small-scale exploratory mining activities. These actions have included: the creation of secondary unmaintained routes extending over much of the site; excavation of test trenches in the central portion of the project area; exploratory drilling activity throughout the site; and placement of numerous claim markers throughout the site.

B. Biology of Federal and State Listed Species Known to Occur in the General Area of the Project

Many of the listed and sensitive wildlife and plant species recorded from the general vicinity of the project do not occupy habitats present on the project site. Several are fish and amphibian species (e.g., desert pupfish, razorback sucker, flannelmouth sucker, roundtail chub, Yavapai leopard frog, southwestern toad) closely associated with perennial sources of water not present on or near the mining site. Several bird species (e.g, bald eagle, brown pelican, Yuma clapper rail, Aleutian Canada goose, southwestern willow flycatcher, black rail, black tern, savannah sparrow, mountain plover, least bittern, white-faced ibis) are associated with wetland habitats also absent from the project site and surrounding area. Several remaining species (e.g., Andrew's dune scarab, Colorado Desert fringe-toed lizard, giant spanish needle, Algodones Dunes sunflower) are distributed within

areas of fine windblown sand deposits also not present on or near the project site.

One federally and State listed species, the desert tortoise, is known to occur on the project site, based on prior observations of animals by Chemgold staff. Another Federal proposed-for-listing species, the flat-tailed horned lizard, has the potential to be harmed by project vehicles and equipment travelling north from State Highway 8 along Olgilby Road. The initial one mile of Olgilby Road, extending north from State Highway 8, crosses sandy-based soils favorable for this species. Flat-tailed horned lizards could be encountered while basking along road edges or crossing the pavement in this restricted area.

Flat-tailed Horned Lizard

The flat-tailed horned lizard is a medium-sized horned lizard, approximately six inches in total length, that ranges from southeastern California into extreme southwestern Arizona and Sonora, Mexico. Coloration is usually whitish, with a narrow dark stripe extending down the center of the back. A series of six elongated head scales, typical of the genus, are located at the base of the skull. The centermost of these head spines (called occipital horns) are unusually elongate, and, together with the long flattened tail and center dark dorsal stripe, separate this horned lizard species from all other members of the genus (Smith 1967).

The flat-tailed horned lizard is principally associated with sandy habitats, often interspersed with harder soils that allow colonies of harvester ants, a primary food source for this lizard. The flat-tailed horned lizard is generally considered to be difficult to locate, and relatively rare throughout its geographic range (Norris 1949, Klauber 1939). Regional surveys to determine relative abundance and distribution have confirmed this scarcity (Turner et al, 1978, 1980b), and also suggest declines where prior researchers have documented relatively high abundance, such as at the Algodones Dunes (Mayhew 1965).

In California, the geographic range of the flat-tailed horned lizard extends over approximately 2,700 square miles. A total of 330 square miles of this area, located in the East Mesa and Yuha Basin of central Imperial County, have been identified as optimal habitat for this species (Turner et al. 1980b; Rado, no date). A series of analyses of effects of to flat-tailed horned lizards and habitats have been undertaken. Rado (no date), initially reviewed factors such as agricultural development, pesticide spraying, recreational use, and mineral development within both optimal habitat and the geographic range of this species. He concluded that 52 percent of the geographic range of the flat-tailed lizard in California is within areas subject to one or more use-oriented activities, and that this included 57 percent of optimal habitat

for the species. Subsequent re-evaluation in 1986 concluded that one or more use-oriented activities were occurring on 95 percent of flat-tailed horned lizard optimal habitat (Mayhew and Carlson 1986). Repeat surveys on flat-tailed horned lizard optimal habitat on Bureau of Land Management lands at East Mesa and Yuha Basin have also recorded declines in relative abundance in both areas (Olech, no date). The documented relative scarcity of this species, high degree of threats to habitat, and documented declines in populations have resulted in the proposal to list the flat-tailed horned lizard as a threatened species (58 Federal Register 62624-62629.

There are no records for the flat-tailed horned lizard within 10 miles of the proposed mining project site. Nearest locality records are from the vicinity of Olgilby (Townships 15 and 16 South, Range 20 East), along the eastern edge of the Algodones Dunes. Turner et al. (1980a), completing a range-wide inventory of Public Lands administered by the BLM for the flat-tailed horned lizard, did not document the species within any Townships encompassing the mining project site. Reasons for this apparent absence probably relate to substrate. The project site, access route leading to this site from Olgilby Road, and transmission line corridor consist of desert pavement, coarse gravel, and compacted gravelly sands not occupied by this species.

A potential exists that flat-tailed horned lizards could be encountered by project commuter traffic on Olgilby Road, immediately north of its junction with State Highway 8. Sand sheets, extending east from the Algodones Dunes approximately two miles farther west from the intersection of these highways, provide favorable flat-tailed horned lizard habitat. This sandy-based soil extends north for an approximate distance of one mile at this site.

Desert Tortoise

The desert tortoise was State listed as a threatened species on June 22, 1989 [California Code of Regulations, Section 670.5(b)(4) of Title 14], and federally listed as endangered under the emergency provisions of the Federal Endangered Species Act on August 4, 1989 (54 Federal Register 32326-32331). This latter listing was changed to threatened on April 2, 1990 (55 Federal Register 12178-12191). Reasons for listing included habitat loss and fragmentation and population declines as a result of disease, predation, and Man-induced factors.

The desert tortoise is widely distributed over portions of the Mojave, Sonoran, and Colorado deserts of the western United States and northwestern Mexico. Habitats occupied include plains and valleys in the Mojave Desert, bajadas and low mountain slopes in the Sonoran Desert, and thorn scrub forest in Mexico. Dominant vegetation includes creosote bush, burrobush, Joshua trees, ocotillo, palo verde, and several species of saltbush (Woodbury and

Hardy 1948; Schwartzmann and Ohmart 1977; Berry 1975, 1984).

The desert tortoise is a highly adapted, adept digger. Burrows are constructed to avoid harsh temperatures and to avoid predators. Burrows used by tortoises include a shallow "pallet" that is used regularly during seasonal activity periods, and a deeper, more extensive burrow that is used during periods of inactivity (Woodbury and Hardy 1948; Berry 1975). Burrows may be constructed almost anywhere, including under boulders, canopies of shrubs, wash embankments, or in the open (Woodbury and Hardy 1948, Berry 1972, Burge and Bradley 1976, Coombs 1977).

The species is herbivorous. Tortoises eat a variety of annual flowers, perennial grasses, a few half shrubs, and flowers of perennial shrubs. Desert tortoises also rely heavily on intermittent rainfall to re-hydrate, and will emerge in numbers immediately following the onset of spring and summer rains to drink (Medica et al. 1982).

Desert tortoises are mature at approximately 15-20 years of age (Woodbury and Hardy 1948). One to two clutches of 2-14 eggs are laid during the spring or early summer in or near the females burrow (Miller 1955; Turner et al. 1987). Eggs hatch in about 105-135 days (Coombs 1977). Individual animals may live for over 100 years (Woodbury and Hardy 1948).

Based on an extensive database compiled from over 2000 strip-transects and 30 study plots in California, desert tortoises are distributed over approximately 40,200 square miles. The majority of these lands contain tortoise densities of 0-20 animals per square mile (Berry and Nicholson 1984).

Desert tortoise populations have declined in recent years as a consequence of several factors. Man-induced activities, including urbanization, highway construction, livestock grazing, motorized recreation, utility and pipeline corridors, mineral exploration and development, and energy development, have contributed to habitat loss and degradation (Berry 1984). Populations have also suffered major declines as a result of disease outbreaks and excessive predation by ravens, a major predator of juvenile tortoises (USBLM et al. 1989).

A recovery plan for this species has recently been developed (USFWS 1994a). Goals of the recovery plan seek to initiate a series of monitoring, research, and protection measures to stabilize and increase selected population sites in California. The project area and associated access road leading to the site do not lie within or proximate to any of these selected sites, nor within any designated critical habitat for the desert tortoise. Based on regional transect data compiled by the BLM during the California Desert plan Program, desert tortoise densities throughout this general area range between 0-20 per square mile. The project site

and access road leading to the site lies outside of any BLM-designated Category 1, 2, or 3 desert tortoise habitat.

The mining site and access/utility corridor are within the Eastern Colorado Recovery Unit for the desert tortoise. Management prescriptions for this unit call for establishing a reserve for protective management, focusing on the Chuckwalla Bench, northwest of the mining project area. The mining site and access/utility corridor are not within the proposed boundary of this Chuckwalla Desert Wildlife Management Area (USFWS 1994b).

C. Survey Methods

Survey efforts included the collection of prior project data from the area. Information sources included the California Diversity Database for the Hedges and Olgilby U.S.G.S. 7.5 minute quadrangles, California Native Plant Society records (CNPS 1988, 1994), discussions with Chemgold staff, and review of prior biological surveys conducted for the general area (Turner et al. 1980, Environmental Solutions 1987, USBLM no date, DeDycker and Associates 1994).

The entire project site, and a minimum 500-foot-wide "buffer" extending around the north, east, and south boundary, was systematically surveyed for listed and sensitive wildlife and plant species. A "buffer" along the western project boundary was not surveyed due to low observed tortoise sign in the western project area and increasingly rugged terrain. Surveys consisted of walking 30-foot-wide parallel transects across this area. Biologists conducting this survey recorded observations of live desert tortoises and other sensitive species encountered. Additionally, all tortoise sign, including carcasses, tracks, scat, burrows and pallets were recorded and mapped. For live desert tortoises observed, the following information was recorded: (1) sex; (2) size; (3) condition; and (4) evidence of disease. For carcasses, and estimate of relative time since death, as determined by degree of disarticulation and bone wear, was also made. For scat, an estimate of class, a function of age, was made. Information obtained for desert tortoise burrows and pallets included: (1) dimensions, in centimeters; (2) current condition; and (3) evidence of tortoises or associated sign.

The existing access road (Indian Pass Road) extending northeast from Olgilby Road for 5.0 miles to the southern project boundary, was also surveyed. The survey consisted of walking 30-foot-wide parallel transects to a width of 150 feet along the northerly portion of the road, and to a width of 500 feet along the southerly portion of the road. Data recordation was identical to that used on the project site.

Existing jeep trails extending for 1.1 miles and 0.4 miles north, respectively, of Indian Pass Road to a potential water well site were surveyed to a widths of 600 feet (e.g., 300 feet on each side of the existing road) and 300 feet (e.g., 150 feet on each side of the existing road) walking parallel transects spaced at 30-foot-wide intervals. Data recordation was identical to that used on the project site.

An alternative transmission line alignment extending east from an existing 161-kilovolt transmission line approximately 3.5 miles northwest of the project site was surveyed in an identical manner to that previously described. Parallel transects spaced at 30-foot-widths were walked within a 300-foot-wide corridor during this survey.

Concurrent with the above transect surveys field biologists recorded all other plant and wildlife species and sign observed. A listing of plants and wildlife observed during site inventories is provided in Appendix B.

Supplemental plant surveys were conducted between July 26-30, 1994, and again between February 27 to March 1, 1995, and between April 3 to 6, 1995. Plant surveys during 1995 were scheduled to provide coverage throughout the phenological periods for sensitive ephemeral species that could occur within the project area. All surveyed were conducted on foot. All washes greater than five feet in width were walked during both survey periods. Transects were also walked throughout the low rocky hills in the eastern and northern portions of the project site as well as on the large expanses of desert pavement that predominate in the southern and western portions of the project site. Approximately 35-40 miles were walked during each 1995 survey period.

Supplemental wildlife surveys were conducted between July 26, 1994 and May 13, 1995. These surveys involved "focused" inventories for rodents, deer sign, birds, and evidence of colonial roosting by bats. Specific survey dates are provided in Table 2. A total of four biologists participated in this survey effort. Resumes are provided in Appendix A.

Livetrapping for nocturnal rodents was undertaken between August 13-23, 1994. A total of 50 Sherman livetraps were set in a linear array in each of two areas. Site 1 consisted of desert succulent scrub habitat within a section of a low rocky ridgeline slope in the east-central portion of the project area. Site 2 consisted of a large wash dominated by microphyll woodland in the central portion of the project area. Traps were spaced at approximately 20 foot intervals and baited with mixed grain. Traps were opened shortly after sunset and closed shortly prior to sunrise in order to avoid harming animals. Captured rodents were identified and released unharmed and unmarked at the point of capture. Livetrapping was concluded after a total of 1,000 trap-nights of

effort (e.g., 500 trap-nights within desert succulent scrub habitat and an identical concurrent effort in desert microphyll woodland habitat, conducted over a 10-night period).

Initial transect surveys demonstrated a wide use of the project area by deer. As a means of evaluating extent of deer use, two biologists inventoried all site drainages for deer and sign. In addition to identifying deer sign, relative age of scats (e.g., whether fresh or old), and the direction of travel of deer based on track inspection was also noted. Surveys included the project site and associated wash drainages extending for a distance of up to 1.5 miles from the project site.

During transect surveys, biologists searched for natural caves, shafts, large crevices or fissures, old mine shafts or tunnels, or other natural or man-made features that could serve as colonial roosts for bats. These area inspections were made over the entire project site and associated route/utility corridors. Additionally, these surveys included checks for natural springs, seeps, or man-made water tanks that have been noted as concentration sites for foraging bats in other desert areas (Miller and Stebbins 1964). Concurrent checks of wash banks were also made during this time for evidence of bat use, including deposits of guano.

Bird surveys were conducted during 1995 in four separate periods: February 27 to march 1; April 3 to 6; April 27-28; and May 12-13. Although habitats present on the project site were all inventories, principal emphasis was spent in area washes looking for sensitive species such as the gila woodpecker and LeConte's thrasher. Surveys during the first two periods typically began within 30 minutes of sunrise and lasted all day. All of the washes on the project site were walked once during each survey period. No pre-recorded tapes were played during the initial two bird survey periods. The focus on the latter two survey periods was for the gila woodpecker and LeConte's thrasher. Surveys during these latter two survey periods began at or 20 minutes prior to sunrise and continued for approximately six hours. All major washes were walked at least once each day. Special attention was paid to the location where a single male gila woodpecker was observed during January 1995, with a minimum time of 15-30 minutes spent each day in the vicinity of that location. A tape of the songs and calls of both the gila woodpecker and LeConte's thrasher was played for several minutes every 10-15 minutes during the survey in an effort to elicit response calls.

Table 2. Wildlife and Plant Surveys of Project Area

Type of Survey	Dates of Survey
Transects	
Project Site	July 12-14, 17-31; August 1-9; 18-25; September 1-2; 7-10 May 8-9
Route Corridor	August 11-17
Water Well Corridors	April 6, 27; May 10
Alternate T-line Corridor	August 29-31
Supplemental Plant Survey	July 26-29; February 27-March 3; April 3-6
Supplemental Bird Survey	July 26-29; February 27-March 1; April 3-6; April 27-28; May 12-13
Rodent Livetrapping	August 13-23
Deer Sign	September 11-15

D. Survey Results

General Overview

A total of 116 plant taxa were identified during site surveys. Plants identified were "typical" of wash and desert succulent scrub plant associations in the Colorado Desert. Species included a variety of taxa closely associated with microphyll woodland communities and several species of cacti. A listing of plants observed is provided in Appendix B.

Wildlife species and sign observed during site surveys included 18 reptiles, 50 birds, and 16 mammals (Appendix B). With the exception of the desert tortoise and chuckwalla, all reptile species are common, widely distributed, and lack special management status. Bird species observed included year-around residents, such as Gambel's quail, as well as seasonal migrants such as white-crowned sparrows (*Zonotrichia leucophrys*). Several species of game birds are present on the project site. In additional to quail, mourning dove and white-winged dove (*Zenaida asiatica*) were observed in moderate-to-larger washes. No raptor nests were observed on or near the project site. Raptors consist of low numbers of individual birds that utilize the project area for foraging.

Mammals include a variety of rodents. Dominant rodent species include the Merriam kangaroo rat (*Dipodomys merriami*) and the desert woodrat (*Neotoma lepida*). Livetrapping results are summarized in Table 3. Rodent trapping and observations of diurnal

species indicate that the project site consists of a relatively low number of rodent species, some of which occur in high density. Rodent species composition also remains fairly consistent, irrespective of plant association sampled. Washes also contain significantly lower numbers of nocturnal rodents, possibly as a result of instability due to intermittent flashflooding. No listed or otherwise sensitive rodent species were livetrapped during this study.

Table 3. Results of Livetrapping for Nocturnal Rodents

Species	No. Captures	Frequency	Abundance
Succulent Scrub Habitat			
Merriam kangaroo rat	25	5.0	13.4
spiny pocket mouse	55	11.0	29.5
Bailey pocket mouse	23	4.6	12.3
desert woodrat	83	16.6	44.6
Total	186		
		Trap Success = 37.2%	
Microphyll Woodland Habitat			
Merriam kangaroo rat	9	1.8	16.6
spiny pocket mouse	8	1.6	14.8
Bailey pocket mouse	6	1.2	11.1
desert woodrat	31	6.2	57.4
Total	54		
		Trap Success = 10.8%	

*Total trap-effort of 1,000 trap-nights (e.g. 50 traps run for 10 nights in each habitat); nocturnal species only

Larger mammals include several predators. Kit fox (*Vulpes macrotis*) were frequently observed on the project site. Site use includes both foraging and denning. An active kit fox pupping den with at least two pups was observed on the project site during the current survey. Coyotes (*Canis latrans*) were also frequently observed.

Mule deer are widely distributed throughout the project site and surrounding area. Based on surveys of wash systems for deer and sign, washes are regularly used, with principal movements occurring with single to small numbers of deer travelling at night. Deer were observed singly or in small groups of 2-4 animals in all major east-west trending washes transecting the project site. Deer were also observed travelling between these washes, typically prior to sunrise. Transect surveys confirm that deer regularly use all washes in the project area, and washes extending to a distance of one or more miles outside of project area boundaries.

Additionally, fresh deer tracks and scat was common on the interspersed areas of desert pavement between these washes. Fresh deer tracks indicate free travel by deer throughout the area. No water sources are present on the project site that would serve to concentrate deer use at this location.

Listed Species

A single federally listed species, the desert tortoise, was recorded from the project area during surveys. Desert tortoises were observed throughout the project area and along the access/utility corridor (e.g., Indian Pass Road). Tortoise sign along the alternative transmission line corridor were restricted to intersecting washes in the eastern half of the alignment. Desert tortoises and sign recorded included a total of 33 observations of live animals (including "incidental" observations along routes by company staff and contractors), 247 burrows and pallets, 103 scat, 2 nesting sites (with egg fragments) and 14 carcasses (including disarticulated skeletal fragments) (Figures 4 and 5). Tortoises and sign were most frequently observed in the eastern half of the project area, dominated by two low ridgelines and a moderate-sized wash. Tortoises and sign decreased significantly in the western half of the project area. Reasons for this difference are not known, since topography and soils are similar. Proximity to Indian Pass Road, and regular camping and off-road vehicle use in this area may have contributed to historical declines from vehicle mortality and collection. Two tortoise carcasses found during the access/utility corridor survey showed clear evidence of vehicle-related mortality. Both animals were also killed within the preceding 1-2 years. Tortoises are present in very low densities in the western edge of the project area, dominated by a sharply rising ridgeline dominated by basalt pavement. Tortoise use at this area was restricted to interspersed "finger" drainages. A synopsis of field data is provided in Table 4 and shown in Figures 4 and 5. Field data are presented in Appendix C.

Table 4. Desert Tortoises and Sign Observed In the Chemgold Imperial Project Area

Type of Sign	Total No. Observations
Live tortoises (including incidental obs.)	33
Burrows/Pallets	247
Tortoise Scat	103
Carcasses (including fragments)	14
Nesting Sites	2
Total Adjusted Sign	322

The number of desert tortoises currently present on the project site and associated route/utility corridors is difficult to quantify. Based on regional data generated during the California Desert Plan Program for the species, between 0-20 tortoises per square mile are present. Extrapolating from this data, between 0-48 desert tortoises may currently occupy the project area, adjacent "buffer", road/utility corridor, and alternate transmission line corridor. Reviewing results of intensive site transect surveys for desert tortoises, approximately 33-57 desert tortoises currently occupy this project area and associated "buffers" extending around the project site, pipeline corridor, and alternate transmission line route (Table 5).

Table 5. Estimated Numbers of Desert Tortoises Currently in the Imperial Project Area*

Survey Data		
Number of Observations of Live Animals	=	32
Number of Burrows with Fresh Sign	=	16
No. Class 2 burrows (end not visible)	=	37
Estimated Actual No. Tortoises Seen	=	16**-32
Estimated No. Unobserved Tortoises in Burrows	=	16-25
Estimated Total Number of Tortoises	**=**	**32-57**
BLM Data		
Estimated Regional Tortoise Densities	=	0-20/sq. mi.
Total Acreages Affected (app.)		
Project Site	=	1003.5
Utility/Road Corridor	=	29.4
"Buffer" Surveyed	=	500.0
Total	=	1532.9
Estimated Total Number of Tortoises	**=**	**0-48**

*Includes project site, utility/road route, "buffer", and alternative transmission line route

**Assumes several repeat sightings of same size/sex animals in same area represent a single individual

An adult male Gila woodpecker was observed near the southwest corner of the project site in January 12, 1995, by a biologist monitoring exploratory drilling. The individual woodpecker was originally perched on a large ironwood tree in a large wash near the western border of the project site (Figure 4). Additional searches for this and other Gila woodpeckers, including using recorded bird calls in an effort to elicit a response, were negative. Subsequent search efforts were undertaken later in January, and again between February 27-March 1, April 4-6, April 27-28, and May 11-12, 1995 (Peter Woodman, pers. comm.). Gila woodpeckers are typically very vocal, and thus easy to locate.

They also exhibit a high degree of fidelity to their home territory and are year-round residents. Based on the negative results of this inventory, absence of prior site records, and inappropriate habitat on the project site, this single observation consisted of a transient bird.

A prior records search did not provide any prior supplemental data on the occurrence of any other State or federally listed species within the project site. Several listed and proposed species are known to occur in the Colorado River 15 miles east of the site, and at the Algodones Dunes, 12 miles west of the project site. The absence of any water/wetland habitats precludes any potential for the occurrence of listed and proposed wildlife or plant species closely associated with these habitats. Lack of sandy-based soils also precludes many species of plants and wildlife known to occur in the vicinity of the Algodones Dunes.

Other Sensitive Species

Plants

No State or federally listed, proposed, or candidate species were located on the Imperial Project site, or have been previously recorded from the project site. Two sensitive plant species, fairy duster and winged forget-me-not, were located on the project site and within the adjacent buffer zone. Fairy duster was common in virtually all of the washes throughout the site. A total of 285 individual plants were observed; conservatively, 500 or more plants occur on the site. Fairy duster was restricted to washes, where it was generally present along wash edges and banks. It was most commonly observed in smaller washes that were between 2-8 feet in width (Peter Woodman, pers. comm.).

Winged forget-me-not was uncommonly found in the larger washes throughout the project site. A total of 53 plants were located, although the actual number of plants on the project site is probably higher. Winged forget-me-not is found in washes throughout the Colorado Desert and into the eastern Mojave Desert of California and Nevada (Jepson 1994). It is also found in the Sonoran Desert in Arizona. The winged forget-me-not is classified as a List 4 (e.g., a "watch" list) species by the California Native Plant Society. While such plants are not "rare" from a Statewide perspective, they are uncommon enough that their status should be monitored regularly.

Wildlife

Several currently unlisted wildlife species that are either Category 2 candidates for Federal listing and/or designated State Species of Special Concern were recorded during project site surveys. These species are the chuckwalla, loggerhead shrike, sharp-shinned hawk, northern harrier and American badger. Although

no natural or artificial caves or rock fissures that could support bat colonies are present, one or more sensitive bat species may forage in this area as well. Potentially occurring sensitive bat species include the Federal candidate California leaf-nosed bat, recorded from both the Hedges and Olgilby USGS Quadrangles (CNDDB records).

A total of three chuckwallas were observed during surveys of the project area. All were associated with fractured rocks, where small crevices afforded refuge (Figure 4). Although approximately half of the project site is comprised of rocky substrates consisting of basalt, this area comprises marginal chuckwalla habitat. Rocks present are typically small in size and form a shallow surface layer overlying powdery soils. Large rocks or boulders with fissures, rock rubble with vertical stratification, or weathering rock outcrops that provide optimal habitat for chuckwallas are absent from the project site.

Loggerhead shrikes were frequently observed during transect surveys of the project site, associated route/utility corridor, and within the alternate transmission line corridor. Based on the frequency of these observations, the project area supports both nesting and foraging habitat for this species.

A total of two northern harrier observations were made during the course of this survey. Both observations occurred in September and consisted of a single animal foraging over the western portion of the mining site. Based on these observations, the northern harrier utilizes the project site infrequently for foraging.

A single sharp-shinned hawk was observed in the northwestern portion of the project site during September. This single bird was observed foraging in the largest wash system along the western edge of the project site. No additional observations were made. Based on this single observation, the species probably infrequently forages in larger washes that bisect the project site.

No raptor nests are known to occur on the project site or within the adjacent buffer.

American badgers also infrequently utilize the project area for hunting. A single live badger was observed in a large wash approximately one mile north of the project site during deer surveys in September. Additional badger-excavated rodent burrows were observed in the northern portion of the project area during transect surveys.

No sensitive bat species were recorded during this survey, or have been previously documented from the project site. In addition, no rock fissures, tunnels or shafts favorable for colonial roosting were present on the Imperial Project site. However, several sensitive species of bats are known to occur in the Cargo Muchacho

Mountains, approximately six miles southeast of the Imperial Project site. Surveys of the American Girl Mining Project (DeDyker and Associates 1994) have documented the occurrence of the California leaf-nosed bat, Townsend's big-eared bat, and western mastiff bat. Two other sensitive bat species, the spotted bat and the cave myotis, may also have been heard during surveys of the American Girl Mining Project. Each of the above species may utilize the Chemgold imperial Project site for foraging. Although colonial bat roosting sites are not present on the Imperial Project site, individual bats may roost in palo verde or ironwood trees or may utilize small rock crevices.

The project site contains a potential prey base population of deer for mountain lions. The project area lies near the western edge of the historical range of the Yuma puma, a Federal candidate species. This light-colored race of mountain lion appears to have been closely associated with the lower Colorado River drainage. Nearest locality records to the Chemgold Imperial project site are the Colorado River, 12 miles south of Yuma (1903 record) and the Colorado River, 20 miles north of Picacho (no date) (Hall 1981). A contract survey conducted for the U.S. Fish and Wildlife Service in the 1980's to collect recent possible sightings of the Yuma puma did not result in any new records (Ted Rado, pers. observ.). No mountain lion observations, nor any sign of mountain lions, were recorded during the current survey of the Chemgold Imperial Project area.

4.0. CONCLUSION

Chemgold, Incorporated, plans to operate a large-scale open pit gold mining operation in southeastern Imperial County. Operations will involve extraction of gold-bearing ore, on-site processing, and placement of overburden in designated areas. Associated actions will include construction of haul roads, support facility areas, and a perimeter security fence. The project will last for approximately 10-20 years. Biological surveys of the project site and associated transportation and electrical supply corridors were conducted between the summer of 1994 and spring of 1995. Survey results should be utilized during the preparation of a biological assessment addressing the effects of proposed project actions on wildlife and vegetation and the development of measures to mitigate project-related effects to such species and their habitats.

5.0. LITERATURE CITED

Berry, K.H. 1972.
Report on tortoise relocation project, July 1971 to November 1971. Division of Highways, State of California, in partial fulfillment of Contract F-9353.

Berry, K.H. 1975
Desert tortoise relocation project: status report for 1973. Department of Transportation, State of California. Contract F-9353. 37 pp.

Berry, K.H. and L.L. Nicholson. 1984.
A summary of human activities and their impacts on desert tortoise populations and habitat in California. In: K.H. Berry (ed.): The status of the desert tortoise (*Gopherus agassizii*) in the United States. Rept. to the U.S. Fish and Wildlife Service from the Desert Tortoise Council on Order No. 11310-0083-81. Pp. 61-117.

Burge, B.L. and W.G. Bradley. 1976.
Population density, structure, and feeding habits of the desert tortoise (*Gopherus agassizii*) on a low desert study area in southern Nevada. In: N.J. Engberg, S. Allan, and R.L. Young (eds.). Desert Tortoise Council Proceedings of the 1976 Symposium. Pp. 51-74.

Burge, B.L. and W.G. Bradley. 1976.
Population density, structure, and feeding habits of the desert tortoise (Gopherus agassizii) on a low desert study area in southern Nevada. In: N.J. Engberg, S. Allan, and R.L. Young (eds.). Desert Tortoise Council Proceedings of the 1976 Symposium. Pp. 51-74.

Berry, K.H. (ed.) 1984.
The status of the desert tortoise (Gopherus agassizii) in the United States. Rept. to the U.S. Fish and Wildlife Service from the Desert Tortoise Council on Order No. 11310-0083-81. 838 pp.

California Department of Fish and Game. 1991.
Annual Report on the status of California State Listed Threatened and Endangered Animals and Plants. Sacramento, California. 192 pp.

California Native Plant Society. 1988.
California Native Plant Society's Inventory of Rare and Endangered Vascular Plants in California. Special Publ. No. 5, Sacramento, California. 168 pp.

California Native Plant Society. 1994.
California Native Plant Society's Inventory of Rare and Endangered Vascular Plants in California. Special Publ. No. 5, Sacramento, California, Fifth Edition. 338 pp.

Condor Minerals Management, Incorporated. 1991.
Final Supplemental Environmental Impact Report for the Proposed Chemgold Inc. Pichacho Mine Dulcina Pit Phase 2, Imperial County, California. Prepared for Chemgold, Incorporated, Yuma, Arizona.

DeDecker and Associates. 1994.
Draft Environmental Impact statement, Oro Cruz Operation of the American Girl Mining Project. Prepared by the U.S. Bureau of Land Management, El Centro Resource Area Office, California. 277 pp.

Desert Tortoise Recovery Team. 1993a.
Desert Recovery Plan for the Desert Tortoise (Mojave Population). Prepared for the U.S. Fish and Wildlife Service, Portland, Oregon. 173 pp. + append.

Desert Tortoise Recovery Team. 1993b.
Proposed Desert Wildlife Management Areas for recovery of the Mojave population of the desert tortoise. Prepared for the U.S. Fish and Wildlife Service, Portland, Oregon. 139 pp.

Environmental Solutions. 1987. Final Environmental Impact Report/Environmental Assessment for the proposed VCR mining project, Imperial County, California. Prepared for the U.S. Department of Interior, Bureau of Land Management El Centro Resource Area Office. 184 pp. + append.

Hall, E.R. 1981.
Mammals of North America. 2nd Ed. John Wiley and Sons, New York.

Klauber, L.M. 1939.
Studies of reptile life in the arid southwest. Bull. Zool. Soc. San Diego 14:1-100.

Mayhew, W.W. 1965.
Hibernation in the horned lizard Phrynosoma mcallii. Comp. Biochem. Physiol. 16:103-119.

Mayhew, W.W. and B.A. Carlson. 1986.
Status of the flat-tailed horned lizard (Phrynosoma mcallii) in California. Final report prepared for the California Department of Fish and Game under Contract no. 85/86 C-1355. 34 pp.

Medica, P.A., C.L. Lyons, and F.B. Turner. 1982.
A comparison of 1981 populations of desert tortoises (*Gopherus agassizii*) in grazed and ungrazed areas in Ivanpah Valley, California. In: K. Hashagan (ed.): Desert Tortoise Council Proceedings of the 1982 Symposium. Pp. 99-124.

Miller, A.H. and R.C. Stebbins. 1964.
The Lives of Desert Animals in Joshua Tree National Monument. UC Press, Los Angeles, California. 452 pp.

Munz, P.A. 1974.
A Flora of Southern California. University of California Press. 1086 pp.

Norris, K.S. 1949.
Observations on the habits of the horned lizard, Phrynosoma mcallii. Copeia 1949:176-180.

Olech, L.A. No date.
Status of the flat-tailed horned lizard (Phrynosoma mcallii) on Bureau of Land Management administered land in California. U.S. Dept. of Interior, Bureau of Land Management, El Centro, California. 12 pp. + append.

Rado, T. No date.
Analysis of actual and potential loss of flat-tailed horned lizard (Phrynosoma mcallii) habitat. Draft. U.S. Dept. of Interior, Bureau of Land Management, Sacramento, California. 30 pp.

Schwartzmann, J.L., and R.D. Ohmart. 1977.
Quantitative vegetational data of desert tortoise habitat (Gopherus agassizii) habitat in the lower Sonoran Desert. In: M. Trotter and C.G. Jackson, Jr. (eds.): Desert Tortoise Council Proceedings of the 1977 Symposium. Pp. 112-115.

Smith, H.M. 1965.
Handbook of Lizards. Cornell University Press, Ithaca, New York. 557 pp.

Turner, F.B., P.A. Medica, and H.O. Hill. 1980a.
The status of the flat-tailed horned lizard (Phrynosoma mcallii) at nine sites in Imperial and Riverside Counties, California. Prepared for the U.S. Dept. of Interior, Bureau of Land Management, Riverside, California. Contract YA-512-CT8-58.

Turner, F.B., J.C. Rorabaugh, E.C. Nelson and M.C. Jorgensen. 1980b.
A survey of the occurrence of the flat-tailed horned lizard (Phrynosoma mcallii) in California. Prepared for the U.S. Dept. of Interior, Bureau of Land Management, Riverside, California. Contract YA-512-CT8-58.

Turner, F.B. and P.A. Medica. 1982.
The distribution and abundance of the flat-tailed horned lizard, Phrynosoma mcallii. Copeia 1982:815-823.

Turner, F.B., K.H. Berry, D.C. Randall and G.C. White. 1987.
Population ecology of the desert tortoise at Goffs, California, 1983-1986. Prepared under contract between the Southern California Edison Company and the University of California, by a Memorandum of Understanding and Purchase Order (C1363901) between the Southern California Edison Company and the Bureau of Land Management, and by Contract DE-AC03-76-SF00012 between the U.S. Department of Energy and the University of California. 101 pp.

U.S. Bureau of Land Management. 1980.
The California Desert Conservation Plan, 1980. Prepared by the U.S. Dept. of Interior, Bureau of Land Management, California Desert Plan Program, Riverside, California. 173 pp.

U.S. Bureau of Land Management. 1989.
Environmental assessment for selected control of the common raven to reduce desert tortoise predation in the Mojave Desert, California. Jointly prepared by the U.S. Bureau of Land Management, U.S. Fish and Wildlife Service, and California Department of Fish and Game. 33 pp.

U.S. Bureau of Land Management and California Department of Fish and Game. 1992.
California Statewide Desert Tortoise Management Policy. Prepared by the USBLM, California Desert District, Riverside, California, and the California Department of Fish and Game. 57 pp.

Woodbury, A.M. and R. Hardy. 1948.
Studies of the desert tortoise, Gopherus agassizii. Ecol. Mono. 18:145-200.

This page intentionally left blank
for reproduction purposes.

APPENDIX A

Qualifications of Biologists

Summary of Participation in Project Surveys

Ted Rado:	Tortoise surveys; general wildlife and plant inventory; deer sign survey; reptiles and amphibians; small mammal livetrapping; report preparation
Peter Woodman:	Tortoise surveys; general wildlife and plant inventory; plant surveys; bird surveys
Karen Jones:	Tortoise surveys; general wildlife and plant inventory; deer sign survey
Ken Sweat:	Tortoise surveys

TED RADO

Ted Rado has a B.A. degree in zoology and a M.A. degree in biology. Mr. Rado has a total of 12 years' experience as a wildlife biologist specializing in endangered species compliance with the U.S. Fish and Wildlife Service and the U.S. Bureau of Land Management. As a wildlife biologist with the U.S. Bureau of Land Management, his work included a position as an endangered species specialist at the BLM State Office in Sacramento. Mr. Rado was also employed as a field biologist with the Bureau in the Mojave Desert in Barstow, California, and as a desert tortoise specialist with the BLM in Riverside. As an employee of the U.S. Fish and Wildlife Service, Mr. Rado specialized in reviewing projects for compliance with the Endangered Species Act. In this capacity, Mr. Rado reviewed survey protocols with project consultants, met with developers to discuss issues and negotiate mitigation, prepared Biological Opinions for Federal agencies, and assisted in the preparation of regional conservation plans for Section 10(a) permits. He has also authored three Habitat Conservation Plans and participated in the preparation of six others.

For the past five years, Mr. Rado has worked in the California Desert Conservation Area as a consulting biologist. Work has included project field surveys, preparation of biological assessments and environmental assessments, and completion of State and Federal permitting documents for a variety of projects authorizing the lawful "take" of listed species. Section 10(a) permitting documents have been prepared by Mr. Rado and signed by the U.S. Fish and Wildlife Service for such projects as a State prison facility at Delano and a cogeneration plant near Fresno. Mr. Rado has also represented clients during negotiations with representatives of the U.S. Bureau of Land Management, U.S. Fish and Wildlife Service, County government, and California Department of Fish and Game addressing compensation for listed species. Projects have included mining operations, pipelines, wind power generation, fiber-optic lines, and oilfield development.

PETER WOODMAN

Mr. Woodman has a B.A. degree in biology. Mr. Woodman has worked for 15 years as a biological consultant in the western United States. He is a widely recognized expert on the desert tortoise. As a consultant, he has completed numerous spring surveys of desert tortoise populations for the U.S. Bureau of Land Management. He has also completed endangered and sensitive species inventories for a variety of projects, including the U.S. Army at the Fort Irwin National Training Center, expansion of State Highway 58, a large-scale agricultural development southwest of Needles, a proposed hydroelectric project in the Sierra Nevada Range, a bird-of-prey survey in the California Desert, and a bird and marine mammal survey in Alaska.

Mr. Woodman has prepared a number of publications and technical papers on listed and sensitive species. Papers have been published

on results of breeding and wintering bird surveys, desert tortoise distribution and density, and bird migration. Technical reports have included contract papers on desert tortoise ecology in Arizona and California for the U.S. Bureau of Land Management, portions of a contract study on the status of the desert tortoise prepared for the U.S. Fish and Wildlife Service, and inventories of desert plants and wildlife for the U.S. Department of Defense.

KAREN JONES

Karen Jones has a B.A. in biology. She has 7 years of experience as a wildlife biologist involving endangered species and fisheries biology. As a Scientific Aide with the California Department of Fish and Game, she conducted capture/recapture studies on chinook salmon in the Toulumne River and on several trout species in various lakes and streams in central California. During this period she also conducted a smoltification study on juvenile chinook salmon. Other fisheries experience includes a creel census of the Kings River, white bass eradication in California lakes, a Coded Wire Tag Program to determine return rate of juvenile releases, and a sampling survey on the San Joaquin river of California. As a Biological Technician with the U.S. Forest Service she conducted spotted owl surveys and nest location as well as cattle grazing surveys on the Stanislaus National Forest.

Ms. Jones has also worked as a staff biologist for an international consulting firm. Her duties included development of baseline survey techniques for endangered species, project setup and organization, project field supervisor, field surveys, construction monitoring, environmental compliance, biological assessments, permitting, report preparation, and a development of mitigation measures for a wide range of land use projects involving endangered species. In this capacity, she has worked with such species as the desert tortoise, flat-tailed horned lizard, blunt-nosed leopard lizard, San Joaquin kit fox, San Joaquin antelope squirrel, and a variety of sensitive plants. More recently, she has conducted a variety of projects in the California Desert Conservation Area as an independent consultant. Projects have included gold mining operations, pipelines, transmission lines, and water conveyance systems.

KEN SWEAT

Mr. Sweat has a B.A. degree in biology/mathematics. He is currently a graduate student at Arizona State University, working towards a Master's degree in botany with an emphasis on desert ecosystems. He has a total of 2 years' experience conducting surveys and monitoring projects in the California Desert region. Work has included participation in a desert tortoise survey in the western Mojave Desert for a highway project, and surveying portions of a large-scale interstate pipeline in the desert for tortoises and other sensitive species. He also worked as a team member during a spotted owl inventory in southern Utah.

This page intentionally left blank
for reproduction purposes.

APPENDIX B
Plant and Wildlife Species Observed

Plant Species Observed During Surveys of the Chemgold Imperial Project Site, Imperial County, California

Asclepiadaceae	**Milkweed Family**
Asclepias subulata	ajamete
Sarcostemma cynanchoides	climbing milkweed
Asteraceae	**Sunflower Family**
Ambrosia dumosa	burrobush
Atrichoseris platyphylla	parachute plant
Bebbia juncea	bebbia
Calycoseris wrightii	yellow tack-stem
Chaenactis carphoclinia var. carphoclinia	pebble pincushion flower
Chaenactis stevoides	Esteve pincushion flower
Encelia farinosa	brittle-bush
Hymenoclea salsola	cheesebush
Geraea canescens	desert sunflower
Gutierrezia macrocephala	matchweed
Microseris linearis	silver-puffs
Monoptillon belliodes	Mohave desert star
Perityle emoryi	Emery rock daisy
Porophyllum gracile	odora
Psathyrotes ramosissima	velvet rosette
Stephanomeria pauciflora	desert straw
Trichoptilium incisum	yellow-head
Trixis californica	trixis
Boraginaceae	**Borage Family**
Amsinkia tessellata	checker fiddleneck
Cryptantha angustifolia	narrow-leaved forget-me-not
Cryptantha circumscissa	western forget-me-not
Cryptantha barbigera	bearded forget-me-not
Cryptantha dumetorum	flexuous forget-me-not
Cryptantha micrantha	Nevada forget-me-not
Cryptantha maritima	white-haired forget-me-not
Cryptantha nevadensis	Nevada forget-me-not
Cryptantha holoptera	winged forget-me-not
Pectocarya platycarpa	broad-nutted comb-bur
Tiquilia canescens	tiquilia

Brassicaceae	**Mustard Family**
Descuriana pinnata	yellow tansy mustard
Brassica tournefortii	mustard
Guillenia lasiophyllum	
Streptanthella longirostris	small streptanthus
Lepidium lasiocarpum	peppergrass
Cactaceae	**Cactus Family**
Echinocactus polycephalus	cottontop cactus
Opuntia basalaris	beavertail cactus
Mammalaria tetrancistra	corkseed cactus
Opuntia bigelovii	Bigelow cholla
Opuntia acanthicarpa	golden cholla
Opuntia ramosissima	diamond cactus
Ferocactus cylindriceus	California barrel cactus
Campanulaceae	**Bellflower Family**
Nemacladus rubescens	
Nemacladus glanduliforus	
Chenopodiaceae	**Goosefoot Family**
Chenopodium sp.	
Salsola tragus	Russian thistle
Curcurbitaceae	**Gourd Family**
Curcurbita palmata	coyote mellon
Euphorbiaceae	**Spurge Family**
Chamaesyce polycarpa	prostrate spurge
Chamaesyce albomarginata	rattlesnake spurge
Ditaxis lanceolata	lance-leaved ditaxis
Ditaxis neomexicana	ditaxis
Euphorbia eriantha	beetle spurge
Fabaceae	**Pea Family**
Acacia greggii	cat-claw
Calliandra eriophylla	fairy duster
Cercidium floridum	palo verde
Olneya tesota	desert ironwood
Dalea mollissima	indigobush
Lotus strigosus	lotus
Psorothamnus schottii	indigobush
Calliandra eriophylla	fairy duster
Prosopis velutina var. Torreyana	mesquite

Fouquieriaceae	**Ocotillo Family**
Fouquieria splendens	ocotillo
Geraniaceae	**Geranium Family**
Erodium texanum	desert heron's bill
Hydrophyllaceae	**Waterleaf Family**
Nama demissum	purple mat
Phacelia distans	fat-leaf phacelia
Phacelia crenulata var. *ambigua*	notch-leaved phacelia
Phacelia crenulata var. *minutiflora*	small notch-leaved phacelia
Phacelia fremontii	Fremont phacelia
Krameriaceae	**Rattany Family**
Krameria grayia	white rattany
Krameria erecta	purple heather
Lamiaceae	**Mint Family**
Salvia columbariae	chia
Hyptis Emoryi	desert lavender
Loasaceae	**Loasa Family**
Mentzelia cf. albicaulis	blazing star
Mentzelia involucra	blazing star
Loranthaceae	**Mistletoe Family**
Phoradendron californicum	desert mistletoe
Malvaceae	**Mallow Family**
Eremalche rotundifolia	desert five-spot
Hibiscus denudatus	rock hibiscus
Horsfordia Newberryi	yellow felt-plant
Nytaginaceae	**Four O'Clock Family**
Allionia imbricata	windmill
Mirabilis cf. bigelovii	wishbone bush

Onagraceae	**Evening Primrose Family**
Camisonia boothii var. decorticans	woody-stemmed bottle-washer
Camisonia brevipes	yellow cups
Camisonia claviformis	brown-eyed primrose
Camisonia refracta	narrow-leaved primrose
Papaveraceae	**Poppy Family**
Eschscholtzia minutiflora	little gold poppy
Plantiginaceae	**Plaintain Family**
Plantago ovata	plaintain
Polygonaceae	**Buckwheat Family**
Chorizanthe brevicornu	brittle spine-flower
Chorizanthe corrugata	corrugata
Chorizanthe rigida	rigid spiny-herb
Eriogonum deflexum	skeleton weed
E. inflatum	desert trumpet
E. pusillum	yellow turbin
E. thomasii	Thomas buckwheat
Polemoniaceae	**Phlox Family**
Eriastrum diffusum	woolly-star
Langloisia setosissima var. punctata	lilac langliosia
Langloisia setosissima var. setosissima	bristly langloisia
Gilia latifolia	gilia
Loeseliastrum schottii	calico
Gilia sp.	gilia
Resedaceae	**Mignonette Family**
Oligomeris linifolia	linear-leaved cambess
Scrophulariaceae	**Figwort Family**
Mohavea confertiflora	ghost flower
Simmondsiaceae	**Box Family**
Simmondsia chinensis	jojoba

Solanaceae	**Potato Family**
Lycium andersonii	Anderson thornbush
Lycium andersonii var. deserticola	Anderson thornbush
Nicotiana trigonophylla	desert tobacco
Zygophyllaceae	**Caltrop Family**
Fagonia laevis	smooth-stemmed fagonia
Larrea tridentata	creosote bush
Monocotyledoneae	
Liliaceae	**Lily Family**
Hesperocaulis undulata	desert lily
Poaceae	**Grass Family**
Achnetherum speciosa	needlegrass
Aristida purpurea	triple-awned grass
Bromus madritensis	red brome
Bromus tectorum	downy chess
Erioneuron pulchellum	fluffgrass
Muhlenbergia porteri	Muhlenbergia
Pleuraphis rigida	big galleta grass
Schismus barbatus	split grass

Vertebrate Species Observed During Surveys of the Chemgold Imperial Project Site and Vicinity, Imperial County, California

Reptiles

FAMILY TESTIDINIDAE	**TORTOISES**
desert tortoise	*Gopherus agassizii*
FAMILY GEKKONIDAE	**GECKOS**
banded gecko	*Coleonyx variegatus**
FAMILY IGUANDIAE	**IGUANID LIZARDS**
side-blotched lizard	*Uta stansburiana*
desert horned lizard	*Phrynosoma platyrhinos*
desert spiny lizard	*Sceloporus magister*
zebra-tailed lizard	*Callisaurus draconoides*
desert iguana	*Dipsosaurus dorsalis*
long-nosed leopard lizard	*Gambelia wislizenii*
collared lizard	*Crotaphytus bicinctores*
tree lizard	*Urosaurus ornatus*
chuckwalla	*Sauromalus obesus*
FAMILY TEIIDAE	**WHIPTAILS**
western whiptail	*Cnemidophorus tigris*
FAMILY COLUBRIDAE	**COLUBRID SNAKES**
gopher snake	*Pituophis melanoleucus*
coachwhip	*Masticophis flagellum*
shovel-nosed snake	*Chionactis occipitalis**
patch-nosed snake	*Salvadora hexalepis*
FAMILY VIPERIDAE	**RATTLESNAKES**
sidewinder	*Crotalus cerastes*
western diamondback rattlesnake	*Crotalus atrox*

Birds

FAMILY CATHARTIDAE	**VULTURES**
turkey vulture	*Cathartes aura*

FAMILY ACCIPITRIDAE	**HAWKS**
red-tailed hawk	*Buteo jamaicensis*
northern harrier	*Circus cyaneus*
American kestrel	*Falco sparverius*
sharp-shinned hawk	*Falco striatus*
FAMILY STRIGIDAE	**OWLS**
great horned owl	*Bubo virginianus*
western screech owl	*Otus kennicottii*
FAMILY PHASIANIDAE	**QUAILS**
Gambel's quail	*Lophortyx gambelii*
FAMILY HIRUNDINIDAE	**SWALLOWS**
cliff swallow	*Petrochelidon pyrrhonota*
tree swallow	*Irdopocne bicolor*
barn swallow	*Hirundo rustica*
FAMILY APODIDIAE	**SWIFTS**
Vaux's swift	*Chaetura vauxi*
FAMILY COLUMBIDAE	**PIGEONS AND DOVES**
mourning dove	*Zenaida macroura*
white-winged dove	*Zenaida asiatica*
FAMILY CAPRIMULGIDAE	**NIGHTJARS**
lesser nighthawk	*Chordeiles acutipennis*
poor-will	*Phalaenoptilus nuttallii*
FAMILY PARIDAE	**VERDINS**
verdin	*Auriparus flaviceps*
FAMILY TROCHILIDAE	**HUMMINGBIRDS**
Anna's hummingbird	*Calypte anna*
FAMILY MIMIDAE	**MOCKINGBIRDS AND THRASHERS**
mockingbird	*Mimus polyglottos*
FAMILY TURDIDAE	**ROBINS**
American robin	*Turdus migratorius*

FAMILY ICTERIDAE	**BLACKBIRDS**
boat-tailed grackle	*Cassidix mexicanus*
FAMILY CUCULIDAE	**CUCKOOS**
greater roadrunner	*Geococcyx californianus*
FAMILY PTILOGONATIDAE	**SILKY FLYCATCHERS**
phainopepla	*Phainopepla nitens*
FAMILY TROGLODYTIDAE	**WRENS**
cactus wren	*Campylorhynchus brunneicapillus*
rock wren	*Salpinctes obsoletus*
Bewick's wren	*Thryomanes bewickii*
FAMILY EMBERIZIDAE	**WOOD WARBLERS, ORIOLES, SPARROWS**
house finch	*Carpodacus mexicanus*
black-throated sparrow	*Amphispiza bilineata*
white-crowned sparrow	*Zonotrichia leucophrys*
dark-eyed junco	*Junco oreganus*
lesser goldfinch	*Spinus psaltria*
yellow-rumped warbler	*Dendroica coronata*
black-throated gray warbler	*Dendroica nigrescens*
Wilson's warbler	*Wilsonia pusilla*
Townsend's warbler	*Dendroica townsendii*
FAMILY STURNIDAE	**STARLINGS**
European starling	*Sturnus vulgaris*
FAMILY LANIDAE	**SHRIKES**
loggerhead shrike	*Lanius ludovicianus*
FAMILY MIMIDAE	**THRASHERS**
crissal thrasher	*Toxostoma dorsale*
FAMILY PICIDAE	**WOODPECKERS**
ladder-backed woodpecker	*Dendrocopos scalaris*
gila woodpecker	*Melenerpes uropygialis*

FAMILY TYRANNIDAE	**FLYCATCHERS**
ash-throated flycatcher	*Myarchus migratorius*
western kingbird	*Tyrannus verticalis*
Say's pheobe	*Sayornis saya*
western wood pewee	*Contopus sordidulus*
dusky flycatcher	*Empidonax oberholseri*
FAMILY SYLVIIDAE	**GNATCATCHERS**
blue-gray gnatcatcher	*Poliptila caerulea*
black-tailed gnatcatcher	*Poliptila melanura*
FAMILY CORVIDAE	**CROWS**
common raven	*Corvus corax*

Mammals

FAMILY VESPERTILIONIDAE	**LEAF-NOSED BATS**
western pipistrel	*Pipistrellus hesperus*
FAMILY CRICETIDAE	**NEW WORLD MICE**
desert woodrat	*Neotoma lepida*
FAMILY SCIURIDAE	**SQUIRRELS**
antelope ground squirrel	*Ammospermophilus leucurus*
round-tailed ground squirrel	*Spermophilus tereticaudus*
FAMILY HETEROMYIDAE	**KANGAROO RATS/POCKET MICE**
desert kangaroo rat	*Dipodomys deserti**
Merriam kangaroo rat	*Dipodomys merriami*
spiny pocket mouse	*Perognathus spinatus*
Bailey pocket mouse	*Perognathus baileyi*
FAMILY LEPORIDAE	**HARES**
desert cottontail	*Sylvilagus audubonii*
black-tailed jackrabbit	*Lepus californicus*
FAMILY FELIDAE	**CATS**
bobcat	*Felis rufus*
FAMILY CANIDAE	**FOXES/DOGS/WOLVES**
coyote	*Canis latrans*
desert kit fox	*Vulpes macrotis*

FAMILY MUSTELIDAE	**WEASELS, SKUNKS, BADGERS**
American badger	*Taxidea taxus*
FAMILY CERVIDAE	**DEER**
mule deer	*Odocoileus hemionus*
FAMILY EQUIDAE	**HORSE FAMILY**
wild burro	*Equus asinus*

*Observed in project "buffer" or along project access road

APPENDIX C

Desert Tortoises and Sign Observed During Surveys of the Chemgold Imperial Project Site, Adjacent "Buffer", Access Route, and Utility Line Routes, Imperial County, California

#	Sign	Class*	W (mm)	H (mm)	L (mm)	End Visible?	Habitat/Comments
1	Burrow	1	34	19	210+	No	DP**/22 Class 2 scats
2	Drinker	3					DP
3	Burrow	5	24	17	60	Yes	DP
4	Pallet	2	31	15	27	Yes	DP
5	Pallet	2	30	18	55	Yes	Edge small drainage
6	Burrow	3	32	16	90	Yes	Edge small drainage
7	Burrow	2	33	20	70+	No	DP
8	Scat	2					Single scat
9	Pallet	3	36	19	56	Yes	DP
10	Scat	2					DP/ 2 scats
11	Burrow	1	30	18	77+	No	Probable tortoise inside/ fresh tracks/ DP
12	Burrow	1	24	14	50+	No	DP/recent use w/smoothed entrance ramp
13	Burrow	2	32	16	85+	No	Edge small wash
14	Pallet	3	40	10	20	Yes	Small wash edge/collapsed
15	Pallet	3	27	15	48	Yes	Edge small drainage
16	Burrow	1	27	17	100+	No	Wash/Smoothed entrance ramp
17	Burrow	2	13	8	48+	No	Edge small drainage
18	Burrow	2	30	15	160+	No	Edge small drainage
19	Burrow	3	22	16	65	Yes	Edge small drainage
20	Pallet	2	20	10	25	Yes	Large wash bank
21	Pallet	2	36	18	28	Yes	Large wash bank
22	Pallet	2	36	19	30	Yes	Large wash bank
23	Burrow	2	22	17	50+	No	Edge large wash
24	Scat	3					1 scat
25	Scat	2					4 scat
26	Burrow	3	23	12	120+	No	Edge small drainage
27	Burrow	3	30	15	?		Woodrat nest use/drainage
28	Burrow	2	32	16	80+	No	Edge small drainage
29	Pallet	4	35	17	50	Yes	Side large wash
30	Pallet	4	30	14	30	Yes	Side small wash
31	Burrow	1	35	18	80+	No	DP/tortoise (260 MCL female inside)
32	Burrow	3	40	18	190+	No	DP/5 Class 5 scats
33	Burrow	4	30	16	82	Yes	DP
34	Burrow	3	28	16	150+	No	DP
35	Pallet	4	28	12	24	Yes	DP
36	Burrow	4	30	20	50	Yes	DP
37	Pallet	4	28	4	20	Yes	DP
38	Burrow	4	35	15	?	No	Edge drainage
39	Burrow	3	30	15	50+	No	DP

#	Sign	Class*	W (mm)	H (mm)	L (mm)	End Visible?	Habitat/Comments
40	Pallet	3	38	17	40	Yes	Edge small drainage
41	Pallet	4	26	12	20	Yes	Edge small drainage
42	Carcass	5					Edge small drainage/dead >10 years (260 MCL female)
43	Burrow	3	20	10	87+	No	Edge small wash
44	Burrow	4	30	16	75+	No	Edge small wash
45	Burrow	2	20	9	43+	No	Edge small drainage
46	Burrow	2	20	12	45+	No	Edge small drainage
47	Burrow	1	34	16	95+	No	Probable tortoise inside/2 Class 2 scats at ramp
48	Burrow	1	32	17	100+	No	4 Class 2 scats
49	Burrow	2	26	20	76	Yes	Edge small wash
50	Burrow	1	30	13	90+	No	Probable tortoise/3 Class 2 scats
51	Burrow	2	24	12	42	Yes	In small drainage
52	Scat	2					small wash/1 scat
53	Burrow	4	28	16	56	Yes	In wash bank small wash
54	Scat	3					wash/1 scat
55	Burrow	2	30	16	45	Yes	Wash edge/smooth ramp
56	Burrow	2	28	12	90+	No	DP
57	Burrow	3	26	13	245+	No	Small wash bank
58	Pallet	4	22	11	20	Yes	DP
59	Pallet	3	30	13	34	Yes	DP
60	Burrow	2	32	17	70+	No	DP
61	Burrow	2	32	18	60+	No	DP
62	Pallet	2	37	15	47	Yes	Large wash bank
63	Burrow	2	32	16	85	Yes	Large wash bank
64	Burrow	1	30	15	75+	No	Probable tortoise/ 1 class 2 scat and fresh tracks
65	Burrow	2	28	16	78	Yes	Wash bank
66	Pallet	4	20	12	27	Yes	Edge small drainage
67	Pallet	2	32	16	47	Yes	Edge small drainage
68	Burrow	1	36	18	50+	No	Probable tortoise/1 Class 2 scat and fresh ramp
69	Burrow	2	32	15	58	Yes	DP
70	Pallet	3	20	10	30	Yes	Edge small drainage
71	Carcass	5					DP/fragments/dead >10 yrs
72	Burrow	1	28	14	60+	No	Probable tortoise/4 Class 2 scats and fresh tracks
73	Burrow	4	30	20	88	Yes	DP
74	Pallet	4	20	10	20	Yes	DP
75	Burrow	4	24	13	60+	No	DP
76	Pallet	4	17	9	27	Yes	Edge small wash
77	Burrow	2	30	17	60+	No	Edge small wash
78	Burrow	2	30	18	60+	No	Edge small wash
79	Burrow	2	27	20	100+	No	Edge small wash
80	Pallet	2	26	17	34	Yes	DP
81	Burrow	2	34	18	68	Yes	Edge small wash

#	Sign	Class*	W (mm)	H	L	End Visible?	Habitat/Comments
82	Burrow	2	30	17	65	Yes	Edge small wash
83	Burrow	2	22	18	85	Yes	Edge small wash
84	Burrow	2	30	14	67	Yes	Edge small wash
85	Pallet	4	32	18	56	Yes	DP
86	Burrow	3	23	15	75	Yes	DP
87	Pallet	4	30	10	22	Yes	DP
88	Burrow	3	28	20	145+	No	Edge small wash
89	Pallet	4	32	18	62	Yes	DP
90	Burrow	4	32	15	115	Yes	DP
91	Burrow	5	25	23	110+	No	Edge small drainage
92	Kit Fox Den						Kit fox observed inside
93	Burrow	2	30	18	50	Yes	DP
94	Burrow	2	28	22	60	Yes	DP
95	Burrow	2	38	18	90+	No	DP
96	Pallet	4	20	15	20	Yes	DP
97	Burrow	3	30	13	30	Yes	Edge small drainage
98	Burrow	1	40	22	70+	No	Probable tortoise/fresh tracks
99	Carcass	5					DP/Dead >10 yrs (frags)
100	Burrow	4	20	12	45	Yes	DP
101	Caliche Holes						Wash bank/no sign
102	Pallet	4	20	8	15	Yes	DP
103	Burrow	1	30	20	100+	No	Wash bank/probable tortoise/2 Class 2 scats and fresh tracks
104	Burrow	1	30	20	100+	No	Wash bank/tortoise inside/270 MCL male
105	Scat	2					Road edge/1 scat
106	Scat	2					DP/1 scat
107	Burrow	4	32	14	38	Yes	Edge small wash
108	Pallet	3	26	12	64	Yes	DP
109	Scat	2					DP/ 2 scat
110	Burrow	3	29	17	75	No	DP
111	Burrow	4	30	15	?	No	DP/woodrat nest inside
112	Burrow	3	15	10	35	Yes	Edge small wash
113	Burrow	5	20	15	36	Yes	Wash edge/unlikely tortoise burrow
114	Burrow	3	30	18	40	Yes	Edge small wash
115	Burrow	1	30	15	80+	No	Edge wash/tortoise inside/ 260 MCL female
116	Burrow	2	32	16	90+	No	Small wash
117	Burrow	2	32	18	60+	No	DP
118	Carcass	4					DP/subadult male (MCL 120)/dead 3-5 yrs
119	Burrow	3	20	14	110+	No	DP
120	Burrow	3	30	23	62	Yes	DP
121	Carcass	5					DP/single fragment/dead >10 yrs

#	Sign	Class*	W (mm)	H	L	End Visible?	Habitat/Comments
122	Carcass	5					DP/single fragment/dead >10 yrs
123	Burrow	3	39	17	100+	No	Edge small wash
124	Burrow	3	28	19	95	Yes	Edge small wash
125	Burrow	2	18	8	120+	No	Edge small wash
126	Burrow	1	38	22	110	Yes	Nest site with scattered egg frags at ramp
127	Pallet	4	26	9	35	Yes	DP
128	Caliche Burrow		28	12	62	Yes	Wash bank
129	Pallet	3	27	13	40	Yes	Wash bank
130	Burrow	3	29	17	35	Yes	Wash bank
131	Burrow	3	28	17	50	Yes	Wash bank
132	Kit fox pupping den with app. 200 scat						
133	Burrow	3	30	20	60	Yes	Edge small wash
134	Burrow	2	34	16	75	Yes	Edge small wash
135	Pallet	5	37	22	55	Yes	Edge small wash
136	Burrow	5	30	20	60+	No	Edge small wash
137	Burrow	2	33	15	100+	No	1 Class 5 and 1 Class 3 scat
138	Scat	2					2 scat
139	Scat	3					1 scat
140	Pallet	2	27	12	40	Yes	Wash bank
141	kit fox den with numerous scat						
142	Pallet	4	30	10	30	Yes	Edge small drainage
143	Burrow	3	23	14	75+	No	Edge small drainage
144	Pallet	4	21	12	31	Yes	DP
145	Burrow	2	32	17	80+	No	Edge small wash
146	Burrow	2	32	16	45	Yes	Edge small wash
147	Burrow	3	34	19	95	Yes	Wash bench
148	Pallet	2	42	19	70	Yes	DP
149	Burrow	2	31	17	140+	No	Wash edge
150	Burrow	3	30	15	50+	No	Tortoise previously observed here by Chemgold staff/270 MCL male observed here on 10/4/94
151	Burrow	4	27	18	70	Yes	Wash
152	Pallet	4	19	10	32	Yes	Wash
153	Pallet	4	20	10	10	Yes	Small wash/collapsed
154	Pallet	4	30	15	20	Yes	Edge small wash
155	Burrow	2	28	15	100	Yes	Small wash
156	Burrow	3	32	18	60+	No	Top wash embankment
157	Burrow	3	31	16	40+	No	Top wash embankment
158	Burrow	2	36	18	150	Yes	Edge small wash
159	Pallet	3	30	15	55	Yes	Top wash embankment
160	Burrow	3	30	20	60+	No	Small wash
161	Pallet	3	40	20	50	Yes	Under tree in large wash
162	Pallet	3	30	20	50	Yes	Wash bank/egg shell remains

#	Sign	Class*	W (mm)	H	L	End Visible?	Habitat/Comments
163	Burrow	2	32	15	80+	No	Wash bank
164	Burrow	1	35	15	80+	No	Wash bank/Tortoise inside/270 MCL male
165	Burrow	1	25	15	100+	No	DP/1 Class 2 scat inside
166	Pallet	3	30	15	40	Yes	Wash bank
167	Burrow	3	25	12	60+	No	Wash bank
168	Pallet	3	30	10	30	Yes	Wash bank
169	Pallet	3	30	12	35	Yes	DP
170	Pallet	3	25	12	40	Yes	DP
171	Burrow	3	30	12	60	Yes	DP
172	Pallet	4	20	10	30	Yes	Wash bank
173	Pallet	4	20	10	25	Yes	Wash bank
174	Burrow	5	29	10	60	Yes	Caliche bank in DP
175	Pallet	4	40	18	30	Yes	Small drainage
176	Pallet	4	40	20	50	Yes	Small drainage
177	Burrow	5	44	25	85+	No	Caliche hole-no sign
178	Burrow	5	40	20	70	Yes	Caliche hole-no sign
179	Pallet	3	30	14	55	Yes	Wash bank
180	Pallet	5	28	18	34	Yes	Wash bank
181	Pallet	5	31	16	60	Yes	Wash bank
182	Burrow	4	18	9	70+	No	Edge of wash
183	Pallet	4	24	11	28	Yes	Edge of wash
184	Carcass	5					Wash edge/fragment/dead >10 yrs
185	Scat	2					Wash bank/ 1 scat
186	Live tortoise observed by Chemgold crew on road (no data)						
187	Live tortoise observed by Chemgold crew on road (no data)						
188	Live tortoise observed by biologist on road (Male/MCL 260)						
189	Live tortoise observed on road by biologist (Male/MCL 250)						
190	Burrow	2	32	25	64	Yes	Wash bank
191	Burrow	3	21	10	50	Yes	Wash edge/90 ft N road
192	Pallet	2	30	14	30	Yes	DP
193	Pallet	2	32	18	60	Yes	DP
194	Pallet	3	32	16	38	Yes	Edge small wash
195	Burrow	2	31	14	90+	No	DP
196	Burrow	4	30	16	60	Yes	DP
197	Pallet	4	30	12	30	Yes	DP
198	Pallet	2	24	16	35	Yes	Small Wash
199	Burrow	2	35	20	75	Yes	Small Wash
200	Pallet	2	25	13	31	Yes	Wash bank
201	Pallet	4	21	11	20	Yes	Wash bank
202	Scat	3					Wash/ 1 scat
203	Scat	2-3					Wash bank/ 2 scat
204	Burrow	5	23	14	62	Yes	DP/badger digout
205	Scat	3					DP/ 1 scat
206	Burrow	5	24	14	85+	No	DP
207	Burrow	5	23	11	31	Yes	Wash bank
208	Burrow	5	24	13	60+	No	DP

#	Sign	Class*	W (mm)	H (mm)	L (mm)	End Visible?	Habitat/Comments
209	Pallet	5	23	12	32	Yes	DP
210	Scat	4					DP/ 1 scat
211	Scat	2					1 scat
212	Pallet	2	22	11	30	Yes	Wash bank
213	Scat	2					DP/ 1 scat
214	Burrow	1	29	14	105	Yes	Tortoise inside/275 MCL male
215	Burrow	3	28	14	55	Yes	Bank small wash
216	Burrow	2	29	12	48+	No	DP/7 old scat
217	Scat	3					1 scat
218	Scat	2					3 scat
219	Burrow	3	30	14	85+	No	DP
220	Burrow	3	32	15	50	Yes	DP
221	Scat	3					2 scat
222	Scat	5					1 scat
223	Burrow	5	14	25	56	Yes	DP/probable kit fox
224	Burrow	5	11	15	?	No	Wash edge
225	Burrow	4	15	10	31	Yes	DP
226	Burrow	6	24	13	?	No	Large wash
227	Burrow	5	20	17	?	No	Large wash
228	Burrow	5	22	22	75	Yes	Large wash/prob. kit fox
229	Tortoise	(Male/MCL 275)					
230	Burrow	3	27	11	55	Yes	DP
231	Burrow	5	14	8	?	No	DP
232	Burrow	6	15	15	?	No	DP/Probable kit fox
233	Burrow	6	20	20	40	Yes	DP/Probable kit fox
234	Burrow	5	18	11	50	Yes	DP/Possible kit fox
235	Burrow	5	14	20	?	No	DP/Kit fox digout
236	Burrow	4	17	10	?	No	DP
237	Burrow	6	17	13	28	Yes	DP/Kit fox digout
238	Tortoise Tracks (from adult observed by driver at S end project site)						
239	Burrow	5	8	11	?	No	DP/unlikely tortoise
240	Pallet	4	20	8	15	Yes	DP/150 ft S road
241	Pallet	3	30	12	35	Yes	DP/450 ft S road
242	Burrow	2	28	18	100+	No	DP/450 ft S road
243	Burrow	2	34	17	70	Yes	DP/460 ft S road
244	Pallet	4	30	15	10	Yes	DP/500 ft S road
245	Pallet	2	35	17	30	Yes	DP/500 ft S road
246	Burrow	2	30	15	50	Yes	DP/50 ft S road
247	Pallet	4	40	20	40	Yes	60 ft S Road
248	Carcass	5					Road edge/single frag/ dead >10 yrs
249	Pallet	3	12	6	22	Yes	400 ft S road
250	Burrow	3	38	14	100+	No	250 ft S road
251	Burrow	3	20	8	40+	No	Small wash/450 ft S road
252	Pallet	3	22	12	37	Yes	Small wash/350 ft S road

#	Sign	Class*	W (mm)	H	L	End Visible?	Habitat/Comments
253	Carcass						300 ft S road/single frag/ dead >10 yrs
254	Carcass	2					350 ft S road/ 140 MCL male/ dead 1-2 years
255	Burrow	2	25	13	75	Yes	350 ft S road
256	Burrow	1	22	12	60+	No	Small wash/freshly excavated ramp
257	Pallet	3	24	13	30	Yes	Small wash/400 ft S road
258	Burrow	3	38	20	80	Yes	Small wash
259	Burrow	1	40	20	75+	No	Tortoise inside/300 MCL male
260	Pallet	3	20	15	30	Yes	Small wash
261	Burrow	2	34	18	65	Yes	Edge of wash
262	Burrow	1	20	12	40+	No	Probable tortoise inside/fresh tracks and 8 Class 3 scat
263	Pallet	4	25	11	20	Yes	Edge wash/90 ft N road
264	Pallet	4	30	8	20	Yes	DP
265	Burrow	2	25	12	60	Yes	Wash bank
266	Burrow	2	35	18	55+	No	Wash bank
267	Burrow	3	30	18	30+	No	Wash bank
268	Caliche hole		60	30	60	Yes	Wash bank/no tortoise sign
269	Live tortoise observed on road by biologist (female/220 MCL)						
270	Live tortoise observed on road by Chemgold crew (adult; no other data)						
271	Live tortoise observed on road by Chemgold crew (adult; no other data)						
272	Live tortoise observed at burrow/ 300 MCL male						
273	Live tortoise observed on road by water truck operator (adult; no other data)						
274	Burrow	2	25	12	43+	No	
275	Burrow	2	25	12	106+	No	1 Class 2 scat inside
276	Scat	4					1 scat
277	Burrow	2	35	25	90+	No	In wash
278	Burrow	2	30	15	106+	No	In wash
279	Burrow	2	15	7	17	Yes	In wash
280	Scat	3					Bank above wash/ 1 scat
281	Scat	2					DP/ 1 scat
282	Burrow	1	28	15	110+	No	DP/ 1 Class 2 scat inside
283	Burrow	1	30	15	?	No	wash edge/tortoise inside/270 MCL male
284	Burrow	2	30	15	80+	No	Wash edge
285	Burrow	3	34	18	60	Yes	DP
286	Burrow	3	30	12	110+	No	DP
287	Burrow	2	37	21	80	Yes	Edge small drainage
288	Burrow	2	40	18	78	Yes	Edge large wash
289	Burrow	3	21	13	100+	No	Edge small drainage

#	Sign	Class*	W (mm)	H	L	End Visible?	Habitat/Comments
290	Pallet	3	30	13	40	Yes	DP
291	Burrow	2	33	19	100+	No	DP
292	Burrow	2	48	20	120+	No	Edge small drainage
293	Tortoise	100 ft E large wash/250 MCL female					
294	Burrow	3	42	14	60+	No	Edge small drainage
295	Burrow	3	32	13	80+	No	DP
296	Pallet	2	33	18	55	Yes	Edge large wash
297	Burrow	2	31	14	75	Yes	DP
298	Pallet	3	30	14	35	Yes	Small drainage
299	Pallet	2	27	18	50	Yes	DP
300	Burrow	1	40	20	60+	No	Edge wash/tortoise inside 250 MCL male
301	Pallet	2	43	30	60	Yes	Edge small drainage/ 1 Class 3 scat inside
302	Burrow	2	51	25	43+	No	In wash
303	Burrow	2	49	15	43	Yes	In wash/1 scat
304	Pallet	4	25	15	25	Yes	
305	Burrow	2	25	14	56+	No	
306	Burrow	2	28	18	90+	No	
307	Burrow	2	28	18	125+	No	
308	Scat	3					1 scat
309	Scat						1 scat
310	Burrow	2	33	17	100+	No	
311	Burrow	3	36	18	90+	No	
312	Burrow	3	28	18	43	Yes	
313	Pallet	No data collected					
314	Tortoise						230 MCL (sex unknown)
315	Scat	2					1 scat
316	Burrow	2	30	15	40	Yes	
317	Scat	5					1 scat
318	Carcass	3					No other info taken
319	Scat	2					1 scat
320	Carcass	2	260 MCL female, 300 yards N access road in wash				
321	Carcass	2	250 MCL male, dead 1-2 years				
322	Burrow	2	8	4	25+	No	At edge small drainage
323	Tortoise		280 MCL male, walking through area 10/3/94				
324	Carcass	5	Isolated worn fragments, dead > 10 years				
325	Tortoise		260 MCL male, observed in Burrow #74 10/10/94				
326	Tortoise		250 MCL male, observed in Burrow #97 10/4/94				
327	Tortoise		260 MCL male, observed 150 ft N access road and 200 yds W T-line 10/5/94				
328	Tortoise		240 MCL female, observed along road 10/18/94				
329	Tortoise		280 MCL male, observed 10/18/94				
330	Tortoise		250 MCL male, observed on Indian Pas Road 10/18				
331	Burrow	3	23	15	55	Yes	Wash edge
332	Burrow	2	25	16	65	No	Wash edge
333	Burrow	2	23	15	55	Yes	Wash edge

#	Sign	Class*	W (mm)	H	L	End Visible?	Habitat/Comments
334	Pallet	3	20	8	36	Yes	Wash edge
335	Pallet	2	25	12	26	Yes	DP
336	Pallet	2	23	15	36	Yes	Next to 334
337	Scat	2					2 scat
338	Pallet	3	22	13	35	Yes	Wash
339	Pallet	2	32	16	48	Yes	DP
340	Tortoise		220 MCL female, in wash, no sign URDS				
341	Pallet	3	22	13	35	Yes	Wash
342	Pallet	2	22	10	23	Yes	DP
343	Burrow	2	30	13	80+	No	Wash edge
344	Pallet	2	34	15	39	Yes	DP
345	Pallet	2	32	14	40	Yes	DP
346	Scat	2					2 scat
347	Pallet	2	28	13	30	Yes	Wash
348	Pallet	3	40	16	58	Yes	DP
349	Burrow	3	26	16	60+	No	DP
351	Tortoise		235 MCL male, no sign URDS				

*Definitions are as follows:

Pallets/Burrows: Class 1=currently active with tortoise or recent sign; Class 2=good condition, definitely tortoise, no recent sign; Class 3=fair condition, definitely tortoise; Class 4=deteriorated, definitely tortoise; Class 5=good condition, possibly tortoise; Class 6=deteriorated, possibly tortoise.

Scat: Class 1=wet or freshly dried, obvious odor; Class 2=Dry with glaze or some odor, no bleaching; Class 3=dry without glaze or odor, light brown, tightly packed; Class 4=dry without glaze or odor, loose material; Class 5=bleached

Carcasses: Class 1= fresh or putrid; Class 2=normal color, scutes adhering to bone; Class 3=scutes peeled off bone; Class 4=bones falling apart; Class 5=disarticulated

**DP="desert pavement"

This page intentionally left blank
for reproduction purposes.

APPENDIX D

Site Photographs



Central portion of Imperial Project site, looking southwest across project area.



Southern portion of project site, looking northeast across project area.



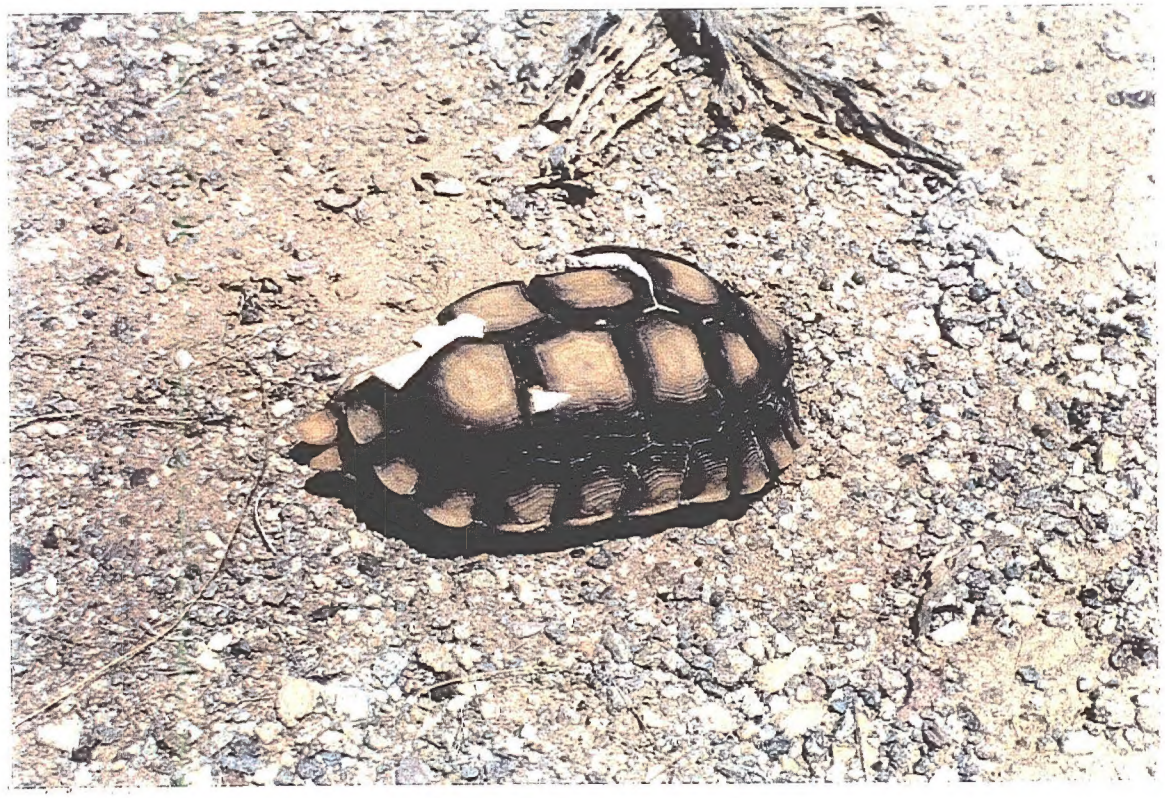
Access road/utility line corridor, looking east along the south side of Indian Pass Road.



Alternate transmission line corridor route, looking east towards the Imperial Project site from western edge of alignment.



Desert wash habitat in central portion of project area, looking south.



Desert tortoise carcass located during surveys of the Imperial Project.

APPENDIX H - POSSIBLE BAT OCCURRENCES ON THE CHEMGOLD IMPERIAL PROJECT SITE

September 28, 1995

To: Chemgold, Inc.
Attn.:Dan Purvance
P.O. Box 758
Winterhaven, CA 92283

From: Patricia E. Brown, Ph.D.
Brown-Berry Biological Consulting
134 Wilkes Crest
Bishop, CA 93514

Regarding: Possible Bat Occurrences on the Chemgold Imperial Project Site.

I have reviewed the Biological Survey report prepared in May 1995, with special attention to the sections pertaining to bats, and have studied the accompanying maps and aerial photographs. I have been conducting bat research in the California Desert since 1968 and in the area of the Cargo Muchacho Mountains and eastern Chocolate Mountains since 1977. I am familiar with the bats of the region, although I have never conducted surveys on the project site. Since no mines, caves or large rock crevices occur on site, Townsend's big-eared bats (*Plecotus=Corynorhinus townsendii*), California leaf-nosed bat (*Macrotus californicus*), western mastiff bat (*Eumops perotis*) and spotted bat (*Euderma maculatum*) would not day roost on the project site. However, these sensitive species could forage over the area at night.

The photographs of the site show well-developed wash vegetation with large desert trees such as ironwoods and palo verdes. Insects and bat foraging activity are concentrated in this habitat. Although open water sources will enhance bat activity, most bat species to not require water to drink and are able to utilize metabolic water from their insect prey. Desert washes are the prime type of foraging habitat for the California leaf-nosed bat. We have documented and banded populations of leaf-nosed bats in the Cargo Muchacho and eastern Chocolate Mountains. Radio-telemetry studies of this species conducted for American Girl Mining Joint Venture have shown that *Macrotus* forage in desert washes, usually within 5 miles of their roosts in warm mines. They feed on moths, grasshoppers and katydids that they glean from the foliage. At night between foraging bouts in the summer, they will roost in the wash trees, but in the colder winter months they return to mines for night roosting. Since no mines or caves occur on the project area, *Macrotus* would not be found roosting there during the day. The closest diurnal roost that I have visited for this species is in an adit just south of the La Colorado Mine in the Cargo Muchacho Mountains (about 4.5 miles from the southern boundary of the project area). Unless a closer, *Macrotus* day roost is discovered in the southeastern Chocolate Mountains, the Imperial Project area probably is not regularly visited by Macrotus.

Other species of bats do travel farther than *Macrotus* from their roosting areas to forage. These include most *Myotis* species, *Eptesicus* and free-tailed bats of the genera *Tadarida* and *Eumops*. Of these, the western mastiff bat can forage within a radius of 50 miles from roosting habitat in boulders and cliff faces. The human-audible echolocation pulses of this bat have been heard over the Cargo Muchacho Mountains throughout the year. The different, but also human-audible, echolocation calls of the spotted bat have been detected a few times over the Cargoes.

Several C2 Federal Candidate *Myotis* species could occur on the project site, including the small-footed myotis (*Myotis ciliolabrum*) and the Yuma myotis (*Myotis yumanensis*). Both little (*Myotis* sp.) and big brown bats (*Eptesicus fuscus*) could roost in trees, such as under the loose bark of ironwood and palo verdes. Their presence would not be noted in most diurnal surveys. Mist-netting and nocturnal monitoring for echolocation signals would be the appropriate survey techniques.

Other species that probably roost and forage on site are the ubiquitous western pipistrelle (*Pipistrellus hesperus*) and the desert pallid bat (*Antrozous pallidus pallidus*), a CDFG Species of Special Concern. Radio-telemetry studies of this large, pale bat have shown that it can roost in narrow crevices in relatively small rocks, with all guano deposited within the rock. Pallid bats forage among desert wash vegetation and over creosote bush scrub for sphinx moths, grasshoppers, scorpions and other large arthropods.

Other bat species could migrate through the project site and may roost in the trees for short periods of time. These include the hoary bat (*Lasiurus cinereus*) and yellow bat (*Lasiurus ega*). Peak migration periods would be early spring and fall. This would also be a period of increased activity in the area of the Mexican free-tailed bat (*Tadarida brasiliensis*). The latter species would forage over the area, but not roost on site.

The attached table lists the bats that could possibly roost on or forage over the project site. Without having conducted a bat survey on site, it is difficult to assess the specific effects of the project on the bat fauna. Generally speaking, the diversity and concentration of bats decreases with the distance from the desert mountain ranges, and therefore the cumulative impacts on bats are reduced in areas of flat terrain not adjacent to the mountains. The project will probably remove roosting habitat in trees and rock crevices for single or small groups of bats. Foraging habitat will also be affected for a greater number of bats that roost off-site, although similar habitat exists adjacent to the Imperial Project area. Please call me if you have any more questions concerning bats likely to utilize this area..

TABLE 1

BATS POSSIBLY OCCURRING ON IMPERIAL PROJECT AREA

Common name	Scientific name	Status	Roost	Forage
Plain-nosed bats	**Family Vespertilionidae**			
Western pipistrelle	*Pipistrellus hesperus*		H	H
California myotis	*Myotis californicus*		H	H
Yuma myotis	*Myotis yumanensis*	C2	L	M
Small-footed myotis	*Myotis ciliolabrum*	C2	M	M
Cave myotis	*Myotis velifer*	C2, CSC	L	M
Occult myotis	*Myotis lucifugus occultus*	C2, CSC	L	L
Big brown bat	*Eptesicus fuscus*		M	M
Pallid bat	*Antrozous pallidus*	CSC	H	H
Townsend's big-eared bat	*Plecotus townsendii* or *Corynorhinus*	C2, CSC	0	L
Spotted bat	*Euderma maculatum*	C2, CSC	0	L
Hoary bat	Lasiurus cinereus		M	M
Western yellow bat	*Lasiurus ega*		L	L
Free-tailed bats	**Family Molossidae**			
Western mastiff	*Eumops perotis*	C2, CSC	0	H
Mexican free-tailed	*Tadarida brasiliensis*		0	H
Leaf-nosed bats	**Family Phyllostomatidae**			
California leaf-nosed	*Macrotus californicus*	C2, CSC	0	L

Possibility of occurrence
0=none L=low M=medium H=high

This page intentionally left blank
for reproduction purposes.

APPENDIX I - DESERT DEER AND THE CHEMGOLD IMPERIAL PROJECT

DESERT DEER

AND THE

CHEMGOLD IMPERIAL PROJECT

Paul R. Krausman

Wildlife Ecology Studies
Oracle, Arizona

Prepared for:
Environmental Management Associates
Brea, California

27 October 1995

DESERT DEER AND THE CHEMGOLD IMPERIAL PROJECT

This report is prepared in response to the request of Environmental Management Associates to collect and review all available information pertaining to the deer which may range through or near the proposed Chemgold, Inc. Imperial project area, located in eastern Imperial County, California, and to provide an appropriate range of recommendations with regard to additional data collection, including any required field work, and/or mitigation measures.

I was also asked to make comments related to bighorn sheep that may range in the vicinity of the Imperial Project. Further discussion about bighorn sheep (in relation to the Imperial Project) is not warranted because the site of the project is not in or adjacent to bighorn habitat. This area does not constitute bighorn habitat and there is no evidence that it is a "corridor" between bighorn habitat.

The enclosed copies of the "Burro Deer Herd Management Plan", the "Burro Deer Herd D-12 Action Plan", and an article by Thompson and Bleich, and the report entitled "Use of Habitat by Colorado Desert Deer", represent the most recent printed information relating to deer that will be influenced by the Imperial Project. They also represent the available management documents for deer in southeastern California. I reviewed them plus the documents your office provided to me. In addition, I obtained information from discussions with Ted Rado (Wildlife Biologist, 3144 Celeste Drive, Riverside, Calif.), N. Andrew, and V. C. Bleich of the California Fish and Game Department. I also visited the Imperial Project on 18 July 1995 and examined much of the area that will be influenced by the project.

Very little is known about the desert deer inhabiting southeastern California; even the name is questionable. In 1897, Mearns described the burro deer (Odocoileus hemionus eremicus, Mearns 1897) as a subspecies. The classification was supported by Cowan (1936) and Hall (1981) but has been questioned by Anderson and Wallmo (1984), Hoffmeister (1986), and Krausman (1994). Brown (1984) argued that O. h. eremicus is different from the desert mule deer (O. h. crooki) but that the correct vernacular for O. h. eremicus is "bura" deer, from the Tohono O'odum and Yuma Indian name for the animal, and not the anglicized "burro" deer. Brown (1984) indicated that burro deer have shorter pelage, a less distinct dorsal stripe, and paler face and skull cap than desert mule deer. Older males (>8 yr) also are large with distinctive wide branching antlers with few tines. Krausman (1994) compared skulls of desert mule deer and burro deer and found significant differences in rostral breadth (i.e., width of snout).

However, Schaefer and Davis (1995) reported that the desert deer of southeastern California had "no unique mitochondrial DNA haplotype when compared to other mule deer populations of North America." Such information justifies an examination of the taxonomy of the deer (Wallmo 1981) to determine whether the populations of the area are different from others.

Information about the life history and ecology of the burro deer are as vague as the taxonomy. The management plan (Celentano and Garcia 1984) and action plan (Schaefer and Davis 1995) cover the entire herd management boundary of 7,026 mi^2 that includes portions of San Bernardino, Riverside, and Imperial counties. It will be difficult to indicate exactly how the removal of habitat (approximately 1,500 acres) from the Imperial Project will

influence the population of deer. However, based on the available data I can offer some potential influences.

Whether the deer are burro or desert mule deer their ecology is similar. Krausman and Etchberger (1993) classified desert mule deer habitat components to include washes with dense vegetation (Krausman et al. 1985), rolling to steep topography (Ordway and Krausman 1986, Bellantoni 1991) and water availability (Hervert and Krausman 1986). This classification appears consistent with available data for burro deer. In late summer, deer move away from the river to the desert mountains and in the late spring they return to the river. Migration routes follow the major desert wash systems (Celentano and Garcia 1984:19). The washes in the Imperial Project were used by deer as evidenced by tracks and pellets. However, rolling to steep topography and water were not in the area. Deer probably use the area as a travel route from the rolling topography north of the project to water and other habitat components south of the project. I doubt there is a resident deer herd in the Imperial project area. In the Belmont Mountains, Arizona, desert mule deer were probably limited more by forage than any other factor, including water (Albert and Krausman 1993) and that area had more vegetation than the desert flats around the Imperial Project.

In other desert deer habitats, fawning often occurs in the higher elevations (Bellantoni and Krausman 1991, Fox and Krausman 1994). Although little is known about fawning around the Imperial Project, most fawning occurred in areas characterized by low, broken hills with vegetated washes near water. Blong (1993) reported that of 8 fawning sites identified in desert deer habitat, 4 were in riparian habitat and 4 were in desert uplands. The nearest water to the Imperial Project is over a mile away and the area is relatively flat. More

fawning probably occurs in the foothills north of the project than in the relatively flat Imperial Project.

Based on my observations, and information from the management plans, the area in and around the Imperial Project is used by deer moving across the desert flats from mountain foothills to water sources or other important habitat components. The area was not consistent with habitat used to support resident herds or as important fawning habitat (Fox and Krausman 1994). However, that does not mean the Imperial Project will not influence deer. Any time habitat is removed there are consequences to the population. Because habitat relationships are so poorly understood in this area, I recommend that Chemgold, Inc. be sensitive to desert deer during their development of the Imperial Project. To mitigate for the altered habitat there are several mechanisms to minimize the impact on deer in the area. It is my understanding that all riparian areas will be modified so that waterflow will not be influenced, the leach pad will be enclosed within a 6 foot high fence, and habitat restoration will occur for all but one of the pits upon project completion. All of these activities will minimize the influence of the project on deer. The first by not reducing waterflow to the overall ecosystem and the second by keeping deer from areas that could be detrimental to them. The pit that remains open should be modified so that deer that enter can escape easily or it could be fenced to prevent any entry. If the open pit also serves as a source of water, safe entry by deer should be facilitated.

I suggest that the areas on all sides of the Imperial Project remain open and undeveloped for 1-5 miles so movements of deer are not restricted. Desert deer have some of the largest home ranges recorded for mule deer (Rautenstrauch and Krausman 1989,

Krausman and Etchberger 1995) to obtain resources necessary for survival in patchy environments and they should not be isolated from these resources.

Other mitigations that have been suggested by various sources include water developments. However, there is little evidence to suggest that water catchments are beneficial for deer unless water is the limiting factor. Water was added to deer habitat in western Arizona to supplement existing water catchments with little influence (Krausman and Etchberger 1995). The population was limited by forage (Albert and Krausman 1993) and unless forage was enhanced, response by the population could not be expected.

Because so little is known about this population, it would be speculation to say that the deer are limited by water. They may just as well be limited by forage. If water catchments were added, the deer population should be monitored so the effectiveness of the mitigation is known.

Water catchments are a popular mitigation in the southwest (Tsukamoto and Stiver 1990). However, their influence is often unknown (Krausman and Etchberger 1995) because their effects on wildlife populations are not measured. If you can't measure it you can't manage it. An alternative mitigation to water catchments for this area could be to provide information about the deer that could be used for effective management.

In conclusion, the area that will be impacted by the Imperial Project is most likely used by deer to travel to various aspects of their habitat. It is unlikely this area supports a resident deer herd. To mitigate for the lost habitat the following is recommended.

1. Fence the area potentially detrimental to deer to prevent entrance by deer and keep gates closed.
2. Ensure water channels are not altered so that waterflow continues.

3. Restore the pits upon project termination and ensure that wildlife can enter and exit the open pit or fence to prevent entry.
4. Keep all sides of the project open for 1-5 miles to ensure movement through the area by deer.
5. Provide information about desert deer ecology that can be used for their management.
6. If water catchments are developed they should be monitored to determine the influence they have on the population. That should include a study prior to and after catchment placement.

Please contact me if you have any questions or would like further elaboration on any part of this report. The literature I cited in this report is listed below.

LITERATURE CITED

Albert, S. K., and P. R. Krausman. 1993. Desert mule deer and forage resources in southwest Arizona. Southwest. Nat. 38:198-205.

Anderson, A. E., and O. C. Wallmo. 1984. Odocoileus hemionus. Mammalian Spp. 219. 9pp.

Bellantoni, E. S. 1991. Habitat use by desert mule deer and collared peccary in an urban environment. M.S. Thesis, Univ. Arizona, Tucson. 71pp.

_____, and P. R. Krausman. 1991. Habitat use by desert mule deer and collared peccary in an urban environment. Natl. Park Serv. Tech. Rep. 42. 39pp.

Blong, Bonnar. 1993. Use of habitat by Colorado desert deer. Calif. Dep. Fish and Game, Region 5. 38pp.

Brown, D. E. 1984. In search of the bura deer. Pages 42-44 in P. R. Krausman and N. S. Smith eds. Deer in the southwest: a symposium. Univ. Arizona, Tucson.

Celentano, R. R., and J. R. Garcia. 1984. The burro deer herd management plan. Calif. Dep. Fish and Game. 90pp.

Cowan, I. M. 1936. Distribution and variation in deer (Genus Odocoileus) of the Pacific Coastal Region of North America. Calif. Dep. Fish and Game 22:155-246.

Fox, K. B., and P. R. Krausman. 1994. Fawning habitat of desert mule deer. Southwest. Nat. 39:269-275.

Hall, E. R. 1981. The mammals of North America. Second ed. Vol 2. John Wiley & Sons, New York, N.Y. 1181pp.

Hervert, J. J., and P. R. Krausman. 1986. Desert mule deer use of water developments in Arizona. J. Wildl. Manage. 50:670-676.

Hoffmeister, D. F. 1986. Mammals of Arizona. The Univ. Arizona Press and Arizona Game and Fish Dep. 602pp.

Krausman, P. R. 1994. The bura deer? Page 251 in D. Gerlach, S. Atwater, and J. Schnell, eds. Deer. Stackpole Books, Mechanicsburg, Pa.

_____, K. R. Rautenstrauch, and B. D. Leopold. 1985. Xeroriparian systems used by desert mule deer in Texas and Arizona. Pages 144-149 in R. Johnson, C. D. Ziebell, D. R. Patton, P. F. Ffolliott, and R. H. Hamre, Tech. Cords. Riparian ecosystems and their management: reconciling conflicting uses. U.S. Dep. Agric. For. Serv.

Gen. Tech. Rep. RM-120.

_____, and R. C. Etchberger. 1993. Effectiveness of mitigation features for desert ungulates along the Central Arizona Project. Final Rep. 9-CS-32-00350, U.S. Bur. Reclamation, Phoenix, Ariz. 308pp.

_____, and _____. 1995. Response of desert ungulates to a water project in Arizona. J. Wildl. Manage. 59:292-300.

Ordway, L. L., and P. R. Krausman. 1986. Habitat use by desert mule deer. J. Wildl. Manage. 50:677-683.

Rautenstrauch, K. R., and P. R. Krausman. 1989. Influence of water availability and rainfall on movements of desert mule deer. J. Mammal. 70:197-201.

Schaefer, B., and J. Davis. 1995. Burro deer herd D-12 Action Plan. Calif. Dep. Fish and Game. Mimeo. 17pp.

Thompson, J. R., and V. C. Bleich. 1993. A comparison of mule deer survey techniques in the Sonoran Desert of California. Calif. Dep. Fish and Game. 79:70-75.

Tsukamoto, G. K., and S. J. Stiver. 1990. Wildlife water development. Proc. Wildl. Water Develop. Symposium, Las Vegas, Nev. 192pp.

Wallmo, O. C., ed. 1981. Mule and black-tailed deer of North America. Univ. Nebraska Press, Lincoln. 605pp.

APPENDIX J-1 - CULTURAL RESOURCES INVENTORY OF INDIAN PASS: AN INVENTORY AND EVALUATION FOR THE IMPERIAL MINE PROJECT, IMPERIAL COUNTY, CALIFORNIA

CULTURAL RESOURCES OF INDIAN PASS: AN INVENTORY AND EVALUATION FOR THE IMPERIAL PROJECT, IMPERIAL COUNTY, CALIFORNIA.

VOLUME I
TECHNICAL REPORT

Prepared for:

Chemgold, Inc.
P.O. Box 758
Winterhaven, California 92283

Prepared by:

ASM Affiliates, Inc.
543 Encinitas Blvd., Suite 114
Encinitas, California 92024
619-632-1094

Jerry Schaefer, Ph.D.
Principal Investigator

Carol Schultze, M.A.
Associate Archaeologist

June 1996

USGS Quadrangle: Hedges, Calif. 1984, 7.5'
Acreage: 1877
Project Type: Intensive Pedestrian Survey
Key Words: Colorado Desert, Indian Pass, Cargo Muchaco Mountains, Chocolate Mountains, Lithic Scatters, Chipping Stations, Lithic Prospects, Trails, Trail Shrines, Geoglyphs, Milling, Cleared Circles, Rock Rings, World War II Desert Training

CULTURAL RESOURCES OF INDIAN PASS: AN INVENTORY AND EVALUATION FOR THE IMPERIAL PROJECT, IMPERIAL COUNTY, CALIFORNIA.

VOLUME I
TECHNICAL REPORT

Prepared for:

Chemgold, Inc.
P.O. Box 758
Winterhaven, California 92283

Prepared by:

ASM Affiliates, Inc.
543 Encinitas Blvd., Suite 114
Encinitas, California 92024
619-632-1094

Jerry Schaefer, Ph.D.
Principal Investigator

Carol Schultze, M.A.
Associate Archaeologist

June 1996

USGS Quadrangle: Hedges, Calif. 1984, 7.5'
Acreage: 1877
Project Type: Intensive Pedestrian Survey
Key Words: Colorado Desert, Indian Pass, Cargo Muchaco Mountains, Chocolate Mountains, Lithic Scatters, Chipping Stations, Lithic Prospects, Trails, Trail Shrines, Geoglyphs, Milling, Cleared Circles, Rock Rings, World War II Desert Training

TABLE OF CONTENTS

Volume I - Technical Report

Management Summary v

Chapter — Page

I. INTRODUCTION 1

II. BACKGROUND 3
A. Location 3
B. Geology 3
C. Biology 6
D. Paleoenvironments 7
E. Cultural Sequence 8
Early Man (Malpais) Pattern (50,000 to 12,000 yrs BP) 9
PaleoIndian Period (San Dieguito) (12,000 to 7,000 yrs BP) 9
Archaic Period (Pinto and Amargosa) (7,000 to 1,500 yrs BP) 11
Late Prehistoric Period (Patayan) (1,500 to 100 yrs BP) 11
Ethnohistoric Yuman (450 to 100 yrs BP) 11
Historic Euro-American (450 yrs BP to present) 12
F. Previous Research 13

III. RESEARCH OBJECTIVES 15

IV. METHODS 17

V. RESULTS 19
A. Prehistoric Resources 19
Chipping Stations/Lithic Scatters 25
Trails and Trail Shrines 27
Cleared Circles and Rock Rings 29
Geoglyphs 29
Possible Bedrock Milling 30
Pot Drops 34
B. Historic Resources 34
C. CA-IMP-2727, -5359T, and -5360T: "The Running Man" Geoglyph Site and Associated Trails 41

TABLE OF CONTENTS

(continued)

Chapter			Page
VI.	EVALUATION AND RECOMMENDATIONS		55
	A.	Significance Evaluation Criteria	55
	B.	Native American Significance	56
	C.	Evaluation Results	58
		Chipping Stations	58
		Cleared Circles	59
		Rock Rings	60
		Trails	61
		Geoglyphs	64
		Pot Drops	65
		Possible Milling Element at CA-IMP-7382	65
		World War II Historic Sites	66
		CA-IMP-2727,-5359T, and -5360T: "The Running Man Geoglyph Site", "Mohave War Trail", and "Black Mesa Trail"	69
	D.	Impacts and Management Recommendation	72
		Chipping Stations	73
		Rock Rings and Cleared Circles	75
		Trails	75
		Geoglyphs	76
		Pot Drops	77
		Sites CA-IMP-2727,-5359T, and -5360T: "The Running Man Geoglyph Site", "Mohave War Trail", and "Black Mesa Trail"	78
VII.	REFERENCES CITED		79

Volume II - Confidential Map and Site Records

Plate 1 Chemgold project and site location map

Site Records

LIST OF FIGURES

Figure		Page
1.	Regional location map	4
2.	Chemgold project boundary	5
3.	Photo of Chipping station (CA-IMP-CG-7415, Feature 21, view north)	26
4.	Photo of trail (CA-IMP-CG-5529, Feature 30, view south)	26
5.	Photo of trail shrine (CA-IMP-7412, Feature 2, view north)	31
6.	Photo of cleared circles (CA-IMP-5529, Feature 8, view north)	31
7.	Photo of geoglyph (CA-IMP-7393, view north)	32
8.	Photo of geoglyph (CA-IMP-7397, view north)	32
9.	Photo of stone *lingam* (CA-(IMP-7398, view south)	33
10.	Photo of milling slick (CA-IMP-7382, Feature 1, view northeast)	33
11.	Map of World War II training site (CA-IMP-5530)	35
12.	Photo of road leading into World War II training site (CA-IMP-5530, view west toward Picacho	37
13.	Photo of rock semicircle at CA-IMP-5530 (shot 15)	37
14.	Photo of rock semicircle at CA-IMP-5530, (Feature 49/H view north	38
15.	Photo of historic rock ring at CA-IMP-5530 (shot 72, view north)	38
16.	Photo of historic rock ring at CA-IMP-5530 (shot 99, view west	39
17	Photo of boulder cairns at CA-IMP-5530	39
18.	Photo of row of cairns at CA-IMP-5530 (view southwest from shot 34)	42
19.	Photo of rock alignment next to cairn at CA-IMP-5530 (shot 92)	42
20.	Photo of portion of trail (CA-IMP-5590T) as it runs through CA-IMP-2727 (view northeast)	43
21.	Photo of portion of trail (CA-IMP-5360T) as it runs through CA-IMP-2727 (view southwest)	43
22.	Map of intersecting trails (CA-IMP-5359T,-5360T) and geoglyph site (CA-imp-2727)	45
23.	Map of CA-IMP-2727	46
24.	Photo of the "Running Man Geoglyph" may be a recent addition to CA-IMP-2727	47
25.	Photo of small rock alignment (Feature 2) at CA-IMP-2727	47
26.	Photo of the 36 meter long rock alignment (Feature 3) at CA-IMP-2727 may be a "spirit break"	49
27.	Photo of disturbed rock cairn (Feature 7) at CA-IMP-2727 may be a trail shrine	49
28.	Malcolm Rogers' 1939 map of CA-IMP-2727 (San Diego Museum of Man)	52

LIST OF TABLES

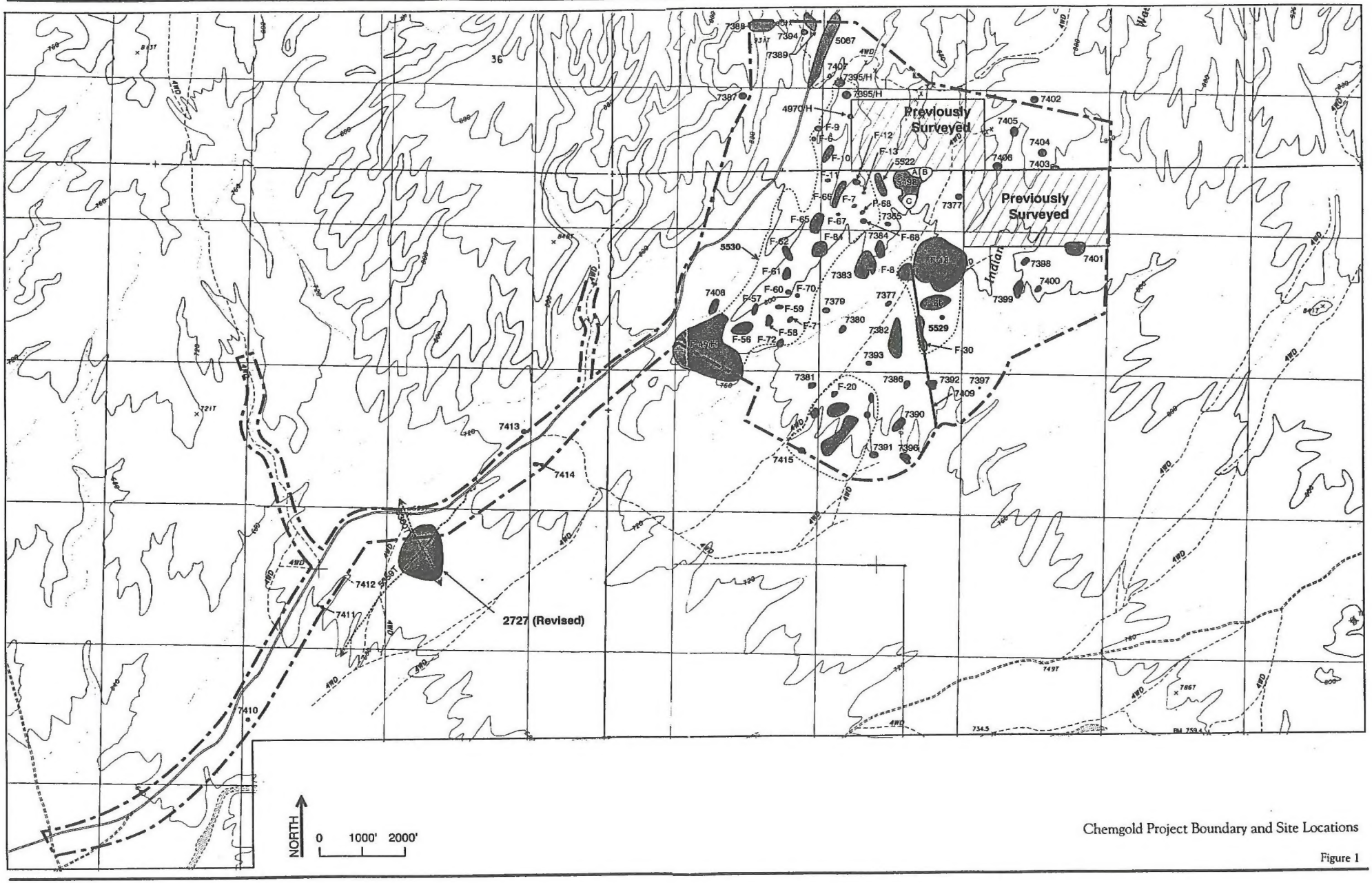
Table Page

1. Site Inventory 20
2. Quantity of Lithics by Material Type and Reduction Stage 27

MANAGEMENT SUMMARY

An intensive pedestrian archaeological survey was undertaken for the proposed Chemgold, Inc. Imperial heap leach gold and silver mine project, located near Indian Pass, Imperial County, California. A total of 2,212 acres were included in the survey area. A 335 acre section of this area was previously surveyed by Brian F. Mooney and Associates in 1991. The present survey area totaled 1,877 acres. A total of 49 sites were recorded in the survey area. Eight of these were updates or expansions of previously known sites. Many of the sites included several features. Specifically, 194 chipping stations, ten trail segments associated with two trail shrines and four pot drops (totaling 35 sherds), 11 cleared circles, three rock rings, three geoglyphs, and one possible milling slick. Two trail segments within the project area intersect at a point outside project boundaries where a ceremonial/geoglyph complex was recorded. Also documented at four separately defined sites were the rock features and trash scatters from a World War II period encampment associated with the Desert Training Center/California-Arizona Maneuver Area.

Among the resources ranked high for significance and evaluated as National Register eligible are the chipping stations and lithic scatters from extensive prehistoric stone sampling and reduction, all of the trails and associated features, and the geoglyphs. The trails and geoglyphs are particularly significant in regards to Native American values and Native American history. Determined not to be National Register eligible are the World War II bivouac area, the rock rings, one of which was determined to be modern, the cleared circles, and the possible milling slick.



Chemgold Project Boundary and Site Locations

Figure 1

I. INTRODUCTION

This report documents the results of an intensive Class III pedestrian survey and cultural resources inventory of the 2,212 acre survey area for the Chemgold Imperial Project, Imperial County, California. The survey was conducted between June 16th and July 11th, 1995. Jerry Schaefer served as the Project Manager and Principal Investigator. Carol Schultze was the Field Director, with Lorey Cachora, Scott Campbell, Eric Fagan, Marc Hintzman, and Steven Pfingst contributing as Assistant Archaeologists. An extended Phase II survey and minimal subsurface evaluation was undertaken between February 13 and 15, 1996 in response to initial BLM comments to the survey draft report. Dr. Jerry Schaefer, Carol Schultz and site mapper Peter Langenfeld undertook more detailed documentation of seven sites to make conclusive significance evaluations and impact projections. Altogether, 49 sites were treated, encompassing a total of 194 chipping stations, four pot drops, 11 cleared circles, three rock rings, ten trail segments, one possible non-portable milling slick, three geoglyphs, and four sites that comprise a World War II era training encampment. Most of the project area is in a light or very light density lithic scatter produced by prehistoric raw stone prospects and reduction activity. Two of the trails intersect south and west of the project area at the so called "Running Man Geoglyph" site.

The environmental and cultural settings are described in Section II to place these finds in ethnographic and historical context. The aboriginal use of this area primarily as a travel route explains much of the use pattern observed in the archaeological record. "Prospecting," or the casual collection of lithic resources while primarily engaged in a different task, is suggested as the predominant resource collection strategy during the prehistoric period (Wilke and Schroth, 1989). The results of previous surveys in the project area are also summarized in Section II. The purpose and goals of this study are delineated in Section III. The methods section (Section IV) states the means through which the cultural resources inventory was accomplished. The discussion of field methods is followed by the results chapter (Section V) in which sites are discussed by type. Sites recorded during a previous 335-acre pedestrian survey within the project area are included in a separate report (Schaefer and Palette 1991). A table that lists sites, their contents, and sizes is provided below. More detailed information and a map of site locations appears in a separate Volume II: California State Parks and Recreation Archaeological Site Records. These are confidential records with site locations and are only available to qualified individuals with a legitimate interest in the data.

The evaluation and recommendations chapter (Section VI) provides a general description of impacts and an evaluation of the National Register eligibility potential of the sites along with an "importance" evaluation under the California Environmental Quality Act. Opportunities for site preservation are identified and recommendations for the mitigation of significant resources that cannot be avoided are set forth in this section. A sampling strategy is recommended to provide information on lithic technology which may be compared to similar data sets from other regions. The geoglyphs and trails are potentially significant as elements of an extensive prehistoric Native American travel and trade network. Recommendations are also given for Native American consultation in treating all of the cultural resources.

II. BACKGROUND

A. Location

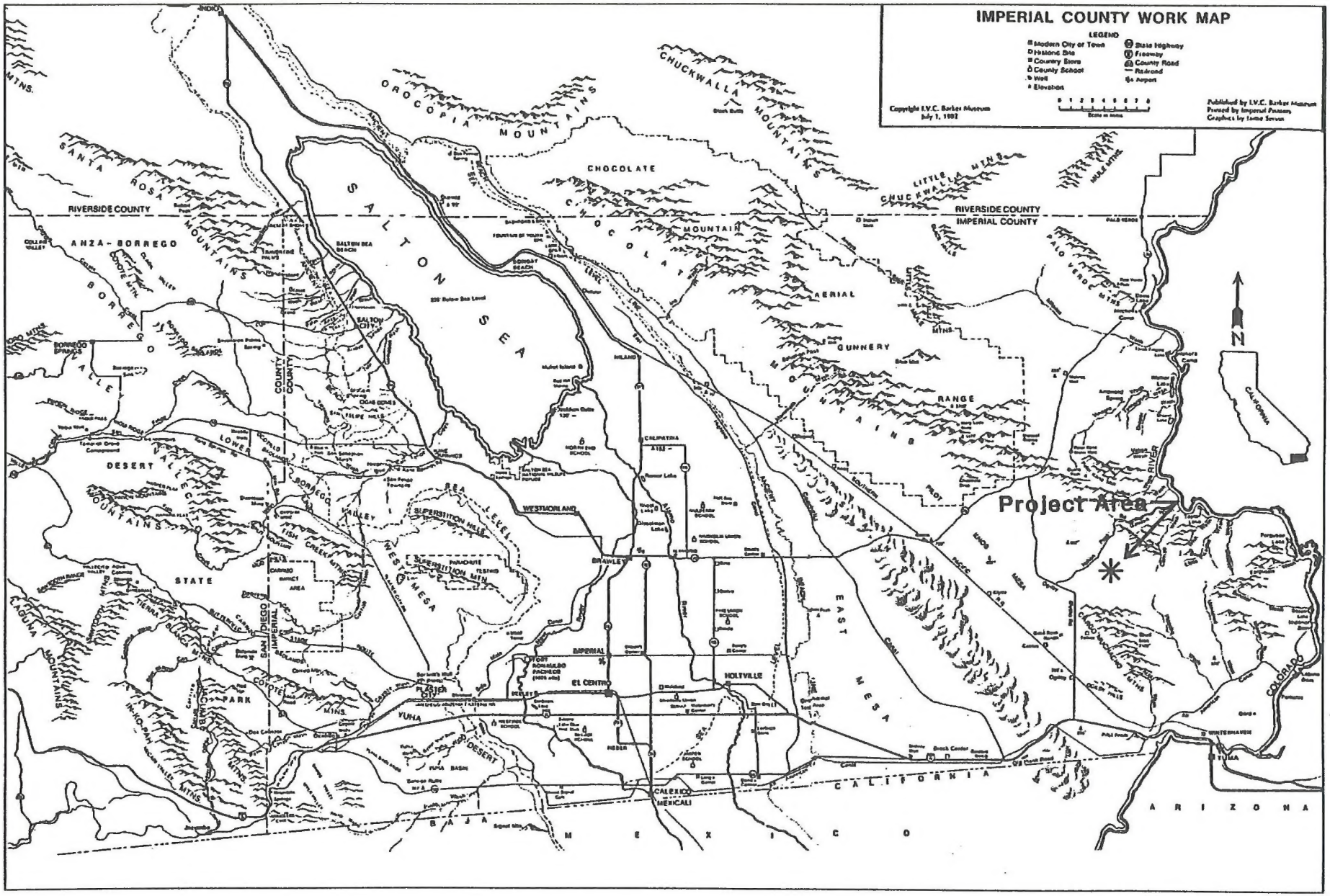
The 2,212 acre Chemgold Imperial Project cultural resources inventory survey area is located north of the Cargo Muchacho Mountains, approximately 22 km north of Yuma, Arizona and 12 km east of Glamis in eastern Imperial County, California (Figure 1). Indian Pass Road runs NE-SW through the property. The main survey area is between 3.04 km and 4.26 km east of Ogilby Road. The survey area also includes a 2.2 km long and 195 m (650 ft.) wide strip along Indian Pass Road, from the southern boundary of the main project area to the road's intersection with a large electric transmission line. The survey area is located within Sections 4, 5, 6, 7, & 8 of T14S, R21E; Sections 31, 32, & 33 of T13S, R21E; and Sections 1,2, & 11 of T14S, R20E Hedges, Ca, USGS 7.5' quadrangle. The surveyed area is 562 acres larger than the 1650-acre Imperial Project area because the cultural resources inventory included a 300 ft. wide buffer zone around the mining project, a 650 ft. buffer zone around Indian Pass Road, and either 150 or 300 ft. buffer zones around access road centerlines and utility corridors (Figure 2).

The Imperial Project survey area (Figure 2) is on the eastern edge of the Salton Trough geographical providence, within the Colorado Desert, and within the western portion of the Lower Sonoran life zone (Sharp 1972:34-41). Few areas of North America are hotter or dryer. Current climatic conditions provide for dry, mild winters and dry, hot summers. Yuma weather records indicate mean winter lows of 44° F and a mean summer temperature of 104° F, with record highs of 120° F. Precipitation in the region is insignificant, with less than 2.5 inches being provided by sporadic winter rains and a few, often violent, summer thunderstorms.

The only nearby permanent water source is the Colorado River, 14 km to the east. As a result, the region's vegetation is sparse and widely distributed. The project area is located on the east side of Pilot Knob Mesa which slopes down from 900 feet above mean sea level (AMSL), at the base of the Chocolate Mountains on the east, to only 350 feet AMSL at the Algodones Sand Dunes on the west. The Chocolate Mountains, located to the east and north of the project area, reach a height of 2,800 feet. Elevations within the project area range from 750 to 880 feet AMSL.

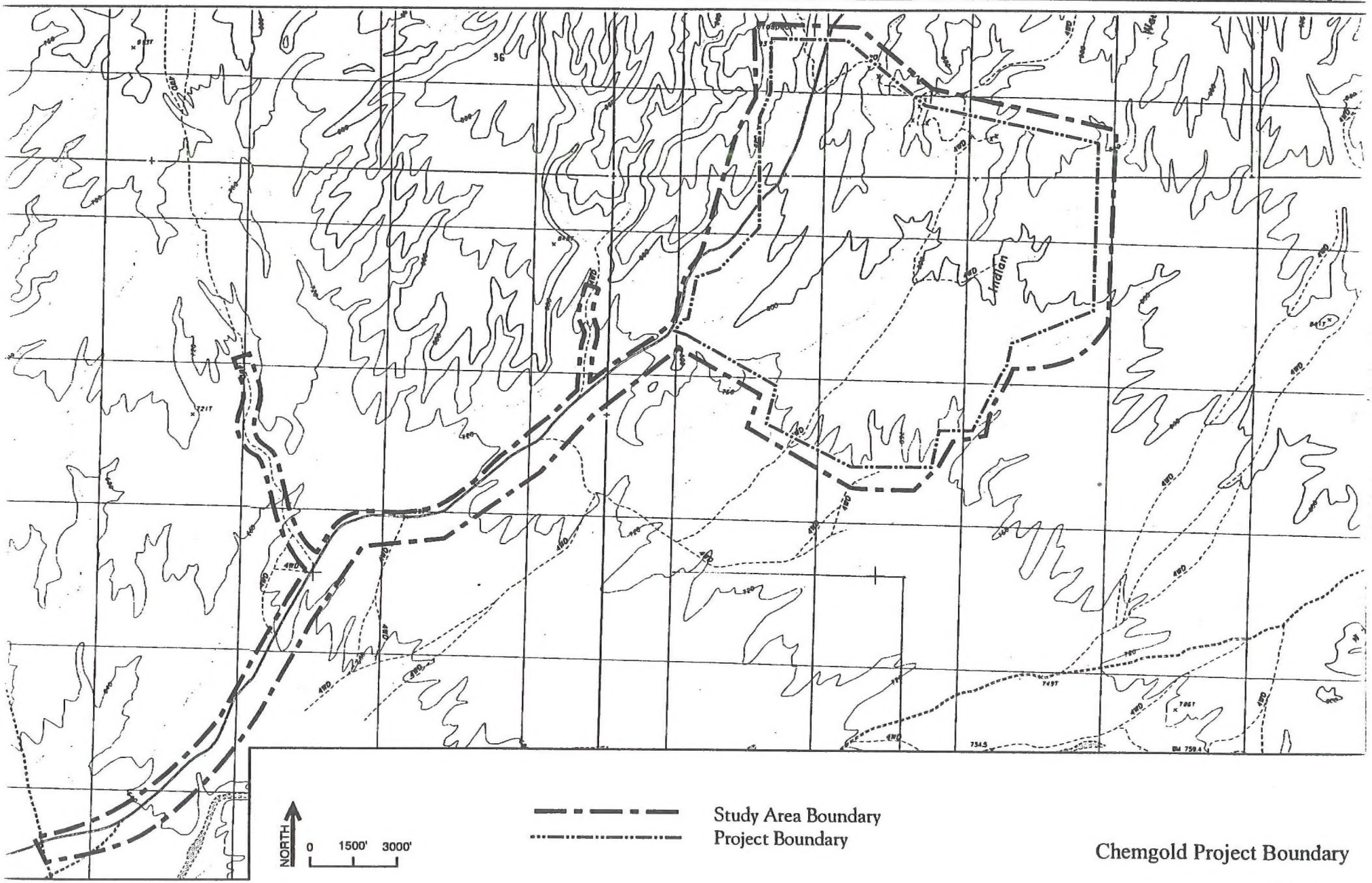
B. Geology

Surface geology of the Indian Pass area is characterized by Pleistocene and Early Holocene alluvial terraces of the Chemehuevis Formation. Alluvial soils fan down from the Chocolate Mountains, and in particular from Black Mountain to the north. These soils are composed of largely unconsolidated, poorly sorted silts and interbedded gravels. Over time, wind and water have eroded away the fine silts and sands that originally formed the suspending matrix of these pebbles, leaving a compact mosaic of stones called desert pavement. The stones of the desert pavement tend to be thickly covered with desert varnish. The majority of in-situ archaeological



Regional Location Map

Figure 1



Chemgold Project Boundary

Figure 2

remains are found on these terraces. The well developed desert pavement-covered terraces are dissected by shallow sandy washes of late Holocene to recent date (Jenkins 1962; Morton 1977; Waters 1984). These washes tend to erode away the older and more stable pavement terraces.

The stones comprising these desert pavements provided the native populations with a variety of raw materials for fashioning stone tools. The most desirable materials were the small, fine-grained cryptocrystalline silicate nodules, usually classified as jasper and chalcedony, that originate from the Mesozoic Era quartz monzonite granite and quartz diorite formations in the Chocolate Mountains. Of poorer quality, but occurring in larger pieces, are the extruded Cenozoic Era volcanics that include basalt and rhyolite.

Desert pavements and many of the stone artifacts found in association with them are frequently covered with red, brown, or black reflective coating. It has long been known that this patination or desert varnish is made up of clay minerals, iron oxides, and manganese oxides originating from airborne dust (Engle and Sharp 1958). Even though the process of desert varnish formation has been much disputed, archaeologists have used observations of thickness and color to estimate the relative age of artifacts (Hester and Heizer 1973; McGuire and Schiffer 1982; Rogers 1966). Most archaeologists realize, however, that this technique is far from reliable but it is often all they have to use for any age determinations given the surficial nature and general lack of temporality diagnostic artifacts on desert pavement archaeological sites. Studies by Dorn and Oberlander (1981) and Dorn (1982) strongly indicate that varnish is laid down by microbial organisms and that the rate of incipient varnish formation may be very short. Recent attempts to date desert varnish through cation-ratio dating methods have proved highly controversial, with the results being generally not accepted by the geological and archaeological communities (Harry 1995, von Werlhof 1984, Bednarik 1988, Dragodovich 1988)

C. Biology

The limited precipitation of the Colorado Desert has produced a sparse Creosote Scrub plant community. The desert pavement terraces occurring in Indian Rose project area are almost denuded of vegetation with most plant life confined to sandy washes. The most commonly occurring species include *Larrea tridentata* (cresote), *Ambrosia dumosa* (burrobush), *Fouquieria splendens* (ocotillo), *Encelia farinosa* (brittle bush), and *Opuntia basilaris* (beavertail cactus). Larger washes also contain some additional species representing the Desert Wash community including *Olneya tesota* (ironwood), *Acacia greggii* (catclaw), *Prosopis* sp. (mesquite), and *Dalea spinosa* (smoketree). Seasonal grasses and *Calliandra eriophylla* (fairy duster) also occur (Jaeger 1965).

While several of the plant species listed above have known aboriginal uses, none occur in sufficient variety or density to make the area an attractive food collecting zone. Only the beans of the mesquite were a preferred food source, while the beans of the iron wood and catclaw were considered quite inferior or to be used only in times of famine. Scarcity of groundstone tools

throughout the area reinforce this interpretation. The lush flood plains of the Colorado River to the east provided plant resources in a greater abundance and with much more reliability.

The fauna observed during the survey of the Imperial Project area include a number of small mammals such as the pocket mouse, kangaroo rat (*Dipodomyy* sp.), black tailed jack rabbit (*Lepus californicus*,) and desert cotton tail (*Sylvilagus auduboni*). Two mule deer (*Odocoileus hemionus*) were seen in the major washes during the survey. Also several desert tortoise (*Gopherus agassizzi*) dens and two dessicated tortoise shells were observed.

D. Paleoenvironments

Evidence of earlier environmental conditions are very limited. Pollen bearing stratified deposits from caves or lake beds are not as common in the Colorado Desert as they are in the Great Basin where most of the desert climatic reconstructions are based. Evidence indicates that the modern desert conditions were already in existence at the beginning of the Holocene Period and the advent of the earliest well-documented cultural occupations (Thompson 1984).

Based on current information, the climatic history of the area may be summarized as follows (Van Devender and Spaulding 1979):

> Late Pleistocene (22,000 to 11,000 B.P.): cooler and wetter conditions supporting Pinyon-Juniper Woodlands, expansive deep lakes, and savannah grasslands at low elevations.
>
> Early Holocene (10,000 to 8,000 B.P.): gradual warming and drying conditions resulting in the shrinking of lakes and replacement of woodlands by creosote scrub communities at lower levels.
>
> Middle to Late Holocene (8,000 B.P. to present): warm and dry conditions continue, dominated by summer monsoons in the desert southwest and winter storms along the Pacific Coast. Lakes in low-lying basins completely dry up or become ephemeral in nature. Locally specific fluctuations in temperature and aridity produced ecological variation of no greater magnitude than known from historic records. Greater frequencies and severity of drought conditions may have existed in the period between 7,000 and 4,500 B.P.

The most important environmental change in the Late Holocene period in the Colorado the Desert was the formation of ancient Lake Cahuilla. Approximately 950 years ago, flooding of the Colorado River caused it to break through its natural deltaic cone at the Gulf of Colorado and flow north into the Salton Trough. For the next 650 years the river periodically poured into what is now Imperial and Coachella Valleys producing a 315 foot deep, 162 mile by 62 mile wide lake, known as Lake Cahuilla. An oasis-like lacustrine environment developed around the shoreline. A string of marshes, and embayments ringed the lake, supporting habitats for shellfish, fish, waterfowl, cattail, and other economically important resources for the local inhabitants (Wilke

1976, 1978). The lake shore attracted people from the Colorado River, the Mojave Desert, and the Peninsular Range. Evidence of this aboriginal population can be found in the large numbers of archaeological sites recorded along the ancient shoreline. The history of Lake Cahuilla is marked by four to five interlacustral intervals during which the shoreline retreated, only to advance again during major infilling cycles. There is also some evidence of earlier Lake Cahuilla intervals in the Archaic period extending back to at least 3,000 years B.P. (Thompson 1968; B. Love 1996). The Colorado River finally returned to its original source about 300 years ago and the lake slowly evaporated to a point where it could not support much wildlife and the native populations ceased to visit the shoreline (Schaefer 1994a, Laylander 1995).

The shoreline of ancient Lake Cahuilla is located approximately 40 km (25 mi) to the west of the Imperial Project area. Thus, even though there may have been little food in this area, there was at least 650 year period of time in which a large lake was reasonably nearby to make this a well traveled and utilized zone. Indian Pass, just 2 km north of the project area, and the major washes running through the general area, were natural corridors for people traveling between the Colorado River and Lake Cahuilla, the Coachella Valley, and/or the Peninsular Ranges. Additionally, lithic materials such as cryptocrystalline silicates, quartz, basalts and rhyolite found on the desert pavement terraces could easily have been collected en-route, providing a convenient way to gather needed tool-making supplies. Additionally, seasonal hunting and gathering activities would have taken place in the area, exploiting what plant and animal resources were seasonally available.

E. Cultural Sequence

A generally accepted outline of Colorado Desert culture history has been recognized by the archaeological community, but not without the realization that it is at best a superficial construct whose details are not well understood. This culture history is based on the pioneering work of Malcolm Rogers in the Picacho Basin and many parts of the Colorado and Sonoran Deserts (Rogers 1939, 1945, 1966). Since then, several overviews and resyntheses have been prepared with each succeeding effort drawing on the previous studies and adding new data and interpretations (M. Weide 1976; Crabtree 1981; Schaefer 1994a). Most culture history reconstructions derive from survey data and surface collected artifacts with extremely uncertain chronological controls. The only major data recovery project on desert pavements, the Picacho Basin Project (Pendleton 1984), as well as smaller testing and excavation projects (e.g. Carrico et al., 1980), confirm that many of the cultural reconstructions for the earliest periods will remain uncertain. Only at late prehistoric ceramic bearing sites will more precise cultural reconstructions be possible (e.g. Wilke 1976).

Six successive periods, each with distinctive cultural patterns, discussed below, may be defined for the Colorado Desert, extending back in time over a period of at least 12,000 years. They are: 1) Early Man (Malpais), 2) PaleoIndian (San Dieguito), 3) Archaic (Pinto and Amargosa), 4) Late Prehistoric (Patayan), 5) Historic Yuman, and 6) Historic Euro-American. The Early Man period is highly speculative. No finds within the Imperial Project area are believed to relate to this time

period. Most of the prehistoric resources are likely to belong to the PaleoIndian, Late Prehistoric, or Historic Yuman times. Some resources from the Historic Euro-American time period were also discovered. These patterns will therefore be discussed in greater detail, with reference to the development of relevant research questions and assignment of cultural affiliations to specific sites.

Early Man (Malpais) Pattern (50,000 to 12,000 yrs BP)

The Malpais Pattern is represented by a complex of archaeological material hypothesized to date from 12,000 to 50,000 years BP (Begole 1973, 1976; Davis et al., 1980; Hayden 1976). The term was originally used by Malcolm Rogers (1939, 1966) for ancient-looking cleared circles, tools, and rock alignments that he later classified as San Dieguito I. The term continued to be applied to heavily varnished choppers and scrapers found on desert pavements of the Colorado, Mojave, and Sonoran deserts that were thought to predate the PaleoIndian period of projectile point makers. Although few would refute that most of the artifacts are culturally derived, dating methods remain extremely subjective and have been assailed on numerous grounds (Taylor and Payen 1979; McGuire 1982:160-164). Arguments for early settlement of the Colorado Desert are further eroded by the redating of the "Yuha Man". Originally dated to over 20,000 years BP based on radiocarbon analysis of caliche deposits, more reliable dates based on the accelerator (ASM) method of actual bone fragments now place the burial at about 5,000 years BP (von Werlhof 1984).

PaleoIndian Period (San Dieguito) (12,000 to 7,000 yrs BP)

Most of the aceramic lithic assemblages, rock features, and cleared circles in the general region of the Imperial Project area have been assigned to the San Dieguito Complex, Phase III (von Werlhof 1984a-c). Indeed, most of the sites in the entire Colorado Desert are assumed to be San Dieguito. Malcolm Rogers first defined the San Dieguito complex based on surface surveys in the Colorado and Sonoran Deserts, but later refined his constructs with excavated material from the C.W. Harris site, a few kilometers from the Pacific coast up the San Dieguito River (Rogers 1929, 1938, 1939, 1966). Rogers saw three phases of the San Dieguito Complex in the Central Aspect, that is the area of the Colorado and Mojave Deserts, and the western Great Basin. Each phase is characterized by the addition of new, more sophisticated tool types to the pre-existing tool kit.

San Dieguito Complex lithic technology is based on primary and secondary percussion flaking of cores and flakes. San Dieguito I and II phase tools include bifacial and unifacially reduced choppers and chopping tools, concave-edged scrapers (spokeshaves), bilateral-notched pebbles, and scraper planes. Appearing in the San Dieguito II phase are finely-made blades, smaller bifacial points, and a larger variety of scraper and chopper types. The San Dieguito III phase tool kit is appreciably more diverse with the introduction of fine pressure flaking. Tools include pressure-flaked blades, leaf-shaped projectile points, scraper planes, plano-convex scrapers, crescentics (amulets) and elongated bifacial knives (Rogers 1939, 1958, 1966; Warren and True 1961; Warren 1967). Various attempts have also been made to seriate cleared circles into phases but no convincing chronological scheme has yet to emerge (Pendleton 1984).

Because of the surficial nature of desert sites and the lack of chronological indicators, it has been difficult to substantiated the validity of Rogers' phase designations as temporal indicators, that is, chronologically successive changes in the tool kit of a long-lived culture. It is conceivable that some of the variations developed contemporaneously in response to ecological or aesthetic requirements. Subsequent excavations at Rogers' C.W. Harris site also failed to confirm his original observation of a stratigraphic separation of Phase II and Phase III assemblages (Warren 1967:171-172). Indeed, in an unstratified context, "phase" distinction may as likely be due to economic specialization at a specific site or sampling error, rather than to technological development. Rogers (1966:39) also identified different settlement patterns for each phase but as Vaughan (1982:6-11) has argued, these distinctions are inadequately defined and inconsistently applied. For these reasons, no phase distinctions will be made for the San Dieguito in future discussions. It will be considered, rather, as a single archaeological and cultural entity with considerable time depth. As data allows, the phase model will be tested and refined, but no de-facto assumptions of temporal phases will be made.

The San Dieguito Culture, as designed by the known complex and site associations, is a hunter-gatherer adaption consisting of small mobile bands exploiting small and large game and collecting seasonally available wild plants. The absence of groundstone from any complex has been seen as reflecting a lack of hard nuts and seeds in the diet, and as a cultural marker separating the San Dieguito Culture from the later Desert Culture (Rogers 1966; Warren 1967; Moratto 1984). Portable manos and metates are now being increasingly recognized at coastal sites radiocarbon dated in excess of 8000 BP and in association with late San Dieguito (III) adaptation. Arguments have also been made for the presence of a developed grinding tool assemblage in earlier periods, based on finds from the Trans-Pecos area of Texas (Ezell 1984). In regards to the Colorado Desert, Pendleton (1984:68-74) remarks that most ethnographically documented pounding equipment for processing hard seeds and wild mesquite and screw beans were made out of wood and do not preserve in the archaeological record.

Settlement patterns also indicate some basic elements of the San Dieguito Culture. Sites are characteristically located on any flat area but the largest aggregations occur on mesas and terraces overlooking the larger washes. Where lakes were present, sites are located around the edges. These are areas where a variety of plant and animal resources could be located and where water would at least be seasonally available. It may be assumed that at the beginning of the Holocene period conditions were slightly wetter, although the climatic evidence reviewed above suggest that the early San Dieguito inhabitants did have to adapt to arid conditions.

Pendleton (1984) has made a strong case, based on ethnographic analogy from Colorado River based tribes, that the San Dieguito occupation in the eastern Colorado Desert was focused on the river floodplain. She tested her model with the large array of sites and data sets in the Picacho Basin, and argues that surrounding desert areas were used only to a limited degree for special resource utilization within a foraging radius of logistically organized collecting groups.

Archaic Period (Pinto and Amargosa) (7,000 to 1,500 yrs BP)

The Pinto Complex and the Amargosa Complex were regional specializations within the existent hunting and gathering adaptations characterizing the Archaic period. These complexes occur more frequently in the northern Great Basin, Mojave Desert, and in the Sonoran Desert east of the Colorado River. Few Pinto or Amargosa (Elko series) projectile points have been identified in the Colorado Desert. It has been suggested that the environment in the California deserts was unstable during these time periods (Crabtree 1981, Weide 1976) which forced the mobile hunter-gatherers into more hospitable regions (Schaefer 1994a).

Late Prehistoric Period (Patayan) (1,500 to 100 yrs BP)

The Patayan is divided into four Phases, including a pre-ceramic transitional phase from 1,500 to 1,200 yrs BP. The major innovations of this period are the introduction of pottery making by the paddle-and-anvil technique around 1,200 yrs BP and the introduction of floodplain agriculture near the same time. Exact dating of early domesticates is lacking (Schroeder 1979). Both these technological advancements were introduced from either Mexico or through the Hohokam culture of the Gila River (Schroeder 1975, 1979, Rogers 1945, McGuire and Schiffer 1982). The flooding of Lake Cahuilla, referred to above, corresponds to Patayan II, 950 to 300 yrs BP. Previous studies suggested that the final recession of Lake Cahuilla occurred around A.D. 1500 but recent research demonstrates that a fifth infilling occurred between A.D. 1600 and 1700 (Schaefer 1994a).

At this time between A.D. 1000 and 1700, desert peoples of this region shifted focus somewhat from the Colorado River floodplains to a more mobile, diversified resource procurement pattern with increased travel between the Colorado River and Lake Cahuilla (Pendleton 1984). Long-range travel to special resource collecting zones, trading expeditions, and possibly some warfare are reflected by the numerous trail systems throughout the Colorado Desert. These trails are often found associated with pot drops, trail-side shrines, and other evidence of transitory activities. New pottery types appeared at this time. Many of the trails seen in the Imperial Project area are expected to date to this time period. Many of the pictographs, petroglyphs and bedrock grinding surfaces in the Colorado Desert have also been associated with the Patayan Pattern, although direct dating and cultural affiliation of such features is difficult to determine. With the recession of Lake Cahuilla, the Patayan III phase emerged, with a returned reliance on the Colorado River floodplain, and some floodplain agriculture along the New and Alamo Rivers, in a mixed horticulture/hunter-gatherer economy.

Ethnohistoric Yuman (450 to 100 yrs BP)

The first historic accounts of the traditional inhabitants of the lower Colorado River were made by Spanish, and later, American explorers. The first professional anthropological account of the lower Colorado Yuman groups was prepared by Kroeber (1920). The group which ethnohistorically inhabited the Imperial Project area was the Quechan (pronounced Kwut-sán). Their traditional lifeways were documented by Forde (1931) in what remains the standard work.

The complexities of their traditional economy, a mix of flood plain horticulture, fishing, and hunting and gathering are detailed by Castetter and Bell (1951). Ethnographies have also been prepared for many of the neighboring groups, as has an area synthesis (Crabtree 1981:40-41; D. Weide 1976:85-87).

The Quechan are a Yuman-speaking group of the Hokan super-family, having linguistic and cultural ties to the Cochimi, Cocopah, Halyikwamai, Kohuana, Kumeyaay, Kiliwa, Walapai, Havasupai, Yavapai, Halchidhoma, Maricopa, and Mohave (Forde 1931, Kroeber 1920). They maintained friendly relationships with the Kumeyaay, Yavapai, Papago and Mohave, but were traditional enemies of the Cocopah and Maricopa to the south and east. Between 1700 and 1850, the Quechan experienced contracted hostilities with the Halchidhoma to the north who probably also used the Indian Pass area, resulting in the ultimate displacement of the Halchidhoma from the Colorado River to the middle Gila river. The Quechan lived in dispersed settlements along the Colorado and lower Gila rivers, relying on both wild and domesticated food sources. The documented trail system through Indian Pass indicates that this was used as a major transportation corridor between the Colorado River and points west, and as a lithic and resource collection area by the Quechan and their ancestors for thousands of years. Quechan collectors were observed in the area as late as 1890 to collect Palo Verde seeds (San Diego Museum of Man Site Records, C-70). This observation may indicate some economic hardship as Palo Verde seeds were regarded as a famine food (Castetter and Bell 1951:196). Today the 33,000 acre Ft. Yuma Indian Reservation remains the center of cultural and political life for the more than 3,000 members of the Quechan Nation (Bee 1981, 1983, 1989).

Historic Euro-American (450 yrs BP to present)

The project area remained peripheral to human activities after the first Spanish contact in AD 1540. Yuma was the center of most events during the three historic phases of Euro-American development: Spanish imperialism and missionization (1540-1821), Mexican and American frontier development (1821-1881), and post railroad modernization (1880-present). Only mining and some military maneuvers left a mark on the cultural landscape of the project area (von Werlhof 1984c:15-17).

Historic Mining

The earliest mining activity within California was started by the Spanish as part of the Yuma Mission colony under the administration of Francisco Garcés. Soldiers, settlers, and laborers mined for gold in the southeastern Chocolate Mountains in 1780 and 1781. Also worked during this period were the placer grounds of Jackson Gulch and the oxide ores of Padre Madre Valley in the Cargo Muchacho Mountains just south of the Imperial Project area. The Padre y Madre Mine located 13 miles northwest of Yuma and 3 miles northwest of Ogilby, was one of the most extensively developed early mines. Mining activities came to an abrupt end on July 17, 1781 when Yuman Indians attacked the mission colony, killing at least 50 men and taking 67 women and children captive. Mining activity only resumed after the establishment of the Mexican Republic in 1823 (Vredenburg 1981, Love 1974). Gold production in the area during the Spanish

and Mexican periods (1780-1848) was of very limited nature and probably did not amount to more than half a million dollars.

Not until the arrival of the Southern Pacific railroad in 1877, linking Yuma with the coast, did mining activity really accelerate. With a safe means of transporting bullion to market at hand, prospectors and developers flooded into the area. Mine districts such as the Cargo Muchacho, Paymaster, Picacho, and Potholes all produced large amounts of gold, copper, silver, manganese, and tungsten until the 1930s, leaving behind ghost towns such as Tumco and Picacho. Easier access afforded by the automobile, especially after World War II, also opened the area to amateur rock collectors in search of jasper, petrified wood, and dumortierite (desert lapis) along Indian Pass. Such visitors were responsible for making some of the more recent looking "chipping stations" and for removing prehistoric artifacts (Weight 1949).

Rising gold prices and improved technologies in the 1960s and 1970s renewed interest in low grade ore and a new gold rush produced large operations such as the Goldfields operation in the Mesquite District, and the American Girl and Hedges/Tumco revitilizations in the Cargo Muchacho mountains.

World War II Desert Training

In 1942 General George S. Patton, Jr. selected much of the Mojave and Colorado desert areas to train troops for the World War II North African Campaigns (Howard 1985). Originally named the Desert Training Center, it was later expanded to Arizona when it was renamed the California-Arizona Maneuver Area (C-AMA). Headquarters for the C-AMA were at a post called Camp Young near Indio, California with numerous other camps spread out through the desert. Patton left with his troops for North Africa in 1942, but the DTC or C-AMA continued throughout the war processing several million troops. Remains of the desert training activities include ordinance shells, tank tracks, bivouac areas, foxholes, rock walls, and tent foundations. One divisional camp opened during the C-AMA period in 1943 was located at Pilot Knob. From Camp Pilot Knob the Indian Pass area was used for training activities by the 85th Infantry Division and the 36th and 44th Reconnaissance Squadrons of the 11th Cavalry Group.

F. Previous Research

Prior to the initiation of field work, a site record search from the Southeast Information Center located at the Imperial Valley College Museum in Ocotilla, California was requested, along with cultural resource reports pertaining to previously studied portions of the project area. This literature review revealed that slightly fewer than 100 prehistoric archaeological sites have been recorded within a one mile radius of the project survey area. A majority of recorded sites within this radius are described as lithic scatters or chipping stations associated with prehistoric prospecting of cryptocrystalline silicates (ccs), rhyolites, basalts and quartz found on the desert pavement. Other sites include prehistoric trails, rock rings, anthropomorphic geoglyphs, pottery scatters, and cleared circles. A single historic site had been previously recorded, IMP-4970H,

which contained two rectangular and one circular rock alignments of unknown age. Most of the prehistoric activity is ascribed to the proximity of the Indian Pass trail system. The geoglyphs may be related to the trails, as a means of transmitting information or for some other purpose.

A survey of the general area was conducted by Imperial Valley College Museum personnel in 1983 (von Werlhof 1984a. 1984b, 1984c). They recorded numerous sites including trails, geoglyphs, rock alignments, lithic stations, rock rings, and temporary camps. Sites in the Imperial Project study area were described as mostly chipping stations and lithic scatters.

A survey team from Brian Mooney and Associates conducted a 335 acre intensive survey within the current project area in April, 1991. Survey boundaries for this project are shown in Figure 2. This survey for drill pads and access roads was conducted for the BEMA mineral exploration project which preceded the Imperial Project/Chemgold project. The two contiguous blocks were intensively surveyed at 20-meter intervals. The survey team recorded an additional 35 chipping stations, 1 pot drop, and 1 trail segment. Additionally, they recorded a rectangular rock foundation, which they suspected to date to World War II. Further work was recommended to clarify the age of the historic site. As part of the survey, some accesses roads and drilling pads were realigned to avoid recorded sites.

In summary, no sites eligible for the National Register of Historic Places were previously recorded within the study area. Cultural resources consist of lithic procurement sites such as lithic scatters and chipping stations. No major habitation sites are located in or near the project area. Travel, construction of geoglyphs in possible association with the trails or symbolic observances, and fortuitous exploitation of workable lithic material are the only activities for which evidence remains.

III. RESEARCH OBJECTIVES

Section 106 of the National Historic Preservation Act (Public Law 89-665; 80 Stat 915; 16 U.S.C. 470; as amended through 1992) requires a Federal agency with jurisdiction over a Federally licensed project to take into account the effect of the undertaking on properties included or eligible for the National Register of Historic Places, and to afford the Advisory Council on Historic Preservation a reasonable opportunity to comment. The 1992 amendments to the law particularly strengthen Native American involvement in the process. In many proposed projects, documents prepared for NHPA compliance procedures dovetail with National Environmental Policy Act requirements and the results are summarized in the Environmental Impact Statement (EIS).

Proof of the significance determination is included in the survey report, testing phase report, or a separate document made available to the SHPO. The inventory and evaluation is usually attached as a confidential technical appendix to the Environmental Impact Statement (EIS), with the results summarized in the EIS. No further action would then be required under the Section 106 process for sites determine not eligible. If significant remains are found that are National Register eligible, then the Federal agency and SHPO will apply the Criteria of Effect (36 CFR 800.9[a]) to the site that may be affected, giving consideration to the views of the Native American community and other interested parties. If the Agency finds that the project will have no effect and notifies the SHPO, then no further action will be taken unless the SHPO files an objection within 15 days. If the Agency finds that the project will have an effect, then the Agency with consultation from the SHPO will apply the Criteria of Adverse Effect (Section 800.9(c)). Under the best of circumstances, a Determination of No Adverse Effect can be made if an approved Treatment Plan is devised to mitigate impacts to the site. This can include avoidance through project design (such as capping the site), and/or development of a research design for data recovery whereby the scientific information and other values associated with the site are recovered before the project proceeds. Regulations require that the Agency obtain SHPO concurrence with the finding and summary documentation provided to the Advisory Council and public (usually requiring a minimum 30-day review period), or submittal of the finding with all documentation to the Advisory Council for a 30-day review period with notification of the SHPO.

The California Environmental Quality Act (CEQA) (Pub. Resources Code § 21000 et seq.) of 1970 was instituted a year after its model, the National Environmental Policy Act, to enable public agencies in California to consider environmental implications of their projects. Significant adverse effects or impacts are identified in an Environmental Impact Report (EIR). Unlike NEPA, CEQA requires agencies to implement feasible mitigation measures or alternatives, identified in the EIR, if the project will cause significant adverse impacts (Remy et al. 1992:11).

Sites determined not to be "important" under CEQA are noted in the Initial Study or EIR but are not considered in further CEQA compliance measures. Sites determined "important" that cannot be avoided or preserved and may be impacted by project design require impact mitigative measures. This can be achieved by preparation and implementation of an excavation plan. Appendix K encourages agencies to include these plans in the EIR. Concurrence with the State

Historic Preservation Officer for site evaluations and mitigation measures is necessary for CEQA compliance.

In cases where a combined EIR/EIS is undertaken because of federal involvement, Appendix K specifies that documents for compliance procedures under NHPA and NEPA may be used in place of technical reports that would be prepared under CEQA. These data, evaluations, and management recommendations are provided to the BLM as the responsible Federal agency so that they can meet their compliance obligations. The evaluations presented below therefore emphasize "significance" and National Register eligibility under 36 CFR 60.4. The same arguments, however, apply to the assessment of "importance" under CEQA, Appendix K.

IV. METHODS

An intensive pedestrian survey was conducted over the entire project area. The survey crew walked the entire area at 20 meter intervals. The last crew member on each transect marked the line with biodegradable flagging, to ensure complete coverage. When a site was discovered, the crew determined the nature and boundaries of the resource and recorded this information on ASM's desert site record form. The site location was drawn on a 1:500' aerial photograph, a sketch map of the local topography was drawn, and photographs of the site and any unusual features were taken. For chipping stations and lithic scatters, an additional form was completed which recorded the stages of lithic reduction present. This information was later used to complete the California State Park and Recreation Cultural Resources form (see Volume II, [confidential]). No collection was undertaken during the survey except for a historic can dump at the largest of the World War II era sites.

Site definitions developed by the BLM were used to type sites in the field and to determine site boundaries once encountered. Sites were defined as containing a minimum of five artifacts within a 25 m^2 area. A 50 m area with no artifacts was the minimum used to separate artifact clusters into distinct sites. Clusters closer than 50 meters were defined as loci of one site. Since this area is characterized by large amounts of cobble testing and early stage lithic reduction, there was an abnormally high occurrence of isolated flakes. For this reason, the crew did not stop at each piece of lithic debris, but merely called out flakes while walking. A concentration of 5 flakes per 25 m^2, or a flaking station were required to begin the site recording process. Areas of light density lithic scatter were tallied by the Field Director. These observations formed the basis for later grouping of chipping stations and other features into larger sites.

V. RESULTS

A. Prehistoric Resources

There can be no doubt that the area in and around the Imperial Project was utilized by pre-contact Native Americans as a travel route and as a source for tool-grade lithics. The distribution of recorded sites is shown in Plate 1 of Volume II (confidential). Although there are no large habitation sites in the immediate area (there are ethnographically documented Quechan villages south of Pilot Knob, at Punta de la Conception, south of Laguna Dam and at the foot of the Chocolate Mountains), the existence of a natural travel corridor along Indian Pass and Indian Pass Wash provided an ample quantity of foot traffic through the area (Pendleton 1984).

The desert pavements here are comprised of a variety of siliceous rocks, quartzites, and vesicular basalts. The tool-making quality of these rocks varies from cobble to cobble. There was not a single reliable source of high quality lithic material in the area, but rather a dispersed source of lithics of good, intermediate, and poor qualities. This lead to a strategy of wide-spread cobble testing. Specifically, when a high quality material was found, rudimentary reduction was carried out on the spot, and the desired blank, preform or flake packed away for later finishing. Wilke and Schroth have characterized this lithic procurement strategy as "prospecting," in order to distinguish it from more intensive and directed "quarrying" of a source of known high quality lithics. They define this as a lithic procurement strategy of:

> "intentionally prospecting for stone at places that sometimes yielded useful material but that never did so consistently or in sufficient quantity to result in what most archaeologists would call aboriginal quarries. . . to find useful material on occasion when they happened to be at the spot for other reasons (Wilke and Schroth 1989:147-148).

This relates to a concept developed by Louis Binford (1979). He discusses "embedded procurement" as a strategy of gathering resources (eg. workable lithics) in anticipation of future need, even if the primary focus of an expedition was something entirely different (eg. travel). In his ethnoarchaeological work with the Nunamiut Eskimo, he notes that expeditions were flexible in purpose, so that the maximum variety of useful resources might be collected. He remarks, "the Eskimo say that only a fool comes home empty handed," and the same might be said for hunter-gatherers in the very different, but equally treacherous environment of the desert.
So, rather than seeing this area as a "quarry," it may be more accurate to view the abundant early stage lithic reduction along the desert pavements as a byproduct, or secondary effect, of the aboriginal travel routes and occasional food gathering forays in the region.

As a result of the survey a total of 49 sites were recorded in the survey area (Table 1). Eight of these were updates or expansions of previously known sites. Many of the sites included several features. Specifically, 194 chipping stations, ten trail segments associated with two trail shrines

Table 1. Site Inventory

Trinomial (Ca-IMP-)	Field Number	Site Type	Artifacts	Area (M^2)	NR Eval.
2727 (update)	CG-78, 79,82	Trails, temporary camp and ceremonial site	2 intersecting trails, 2 rock alignments, "Running Man" geoglyph, trail shrine, 7 chipping stations, ceramic and lithic scatter	52800	E
5067 (update)	CG-40	Trail, pot drop, chipping stations, historic rock alignment	Segment of original Indian Pass trail, parallels Indian Pass road with one spur trending E-W. 3 sherds of Hedges buffware, 3 chipping stations: 70+ ccs flakes, 10+ rhyolite flakes	50000	E
5498 (update)	CG-4	Chipping stations and lithic scatter	12 chipping stations: 4 ccs cores, 59 ccs flakes, 2 quartz cores, 37 quartz flakes, 1 rhyolite preform, 1 ccs unifacial tool--all mod. varnish	43700	E
5522 (update)	CG-5	Chipping stations and lithic scatter	2 chipping stations: 25 ccs flakes, 2 unifacially retouched ccs flakes	4500	E
5529 (update)	CG-86	Cleared circles and prehistoric trail	3 cleared circles, 2 trail segments, 2 ccs chipping stations: 1 ccs core, 10 flakes	1460	E
	feat-8				
	feat-18	Chipping stations	29 chipping stations of ccs, rhyolite, basalt, quartz and quartzite: 19 cores 500+ flakes, 1 ccs biface blank	119025	
	feat-29	Lithic scatter	5 different types of ccs: 2 cores, 11 flakes, 1 rhyolite core	9	
	feat-30	Trail, pot drop, and chipping stations	1 N-S trending trail (segment of CG-64),4 sherds of Hedges buff ceramic, 3 ccs chipping stations: 2 cores, 16 flakes	1960	
5530 (update)	CG-84	Chipping station	1 white ccs chipping station: 1 ccs core, 110 ccs flakes well varnished	4	E
	feat-6				
	feat-7	Chipping station	2 ccs chipping stations: 3 cores, 6 flakes	80	
	feat-9	Chipping station	2 ccs chipping stations: 2 cores, 13 flakes, all stages of varnish present	1036	
	feat-10	Chipping stations	3 ccs chipping stations: 3 cores, 34 flakes, 1 rhyolite primary flake all stages of varnish present	1800	
	feat-11	Chipping station	1 rhyolite chipping station: 1 core, 3 flakes, 10 + ccs flakes	168	
	feat-12	Chipping station	1 ccs chipping station: 9 flakes, low varnish	4	

Trinomial (Ca-IMP-)	Field Number	Site Type	Artifacts	Area (M²)	NR Eval.
5530(cont.)	feat-13	Lithic scatter	10+ ccs flakes, moderate varnish	36	
	feat-49/H	Historic World War II camp and chipping stations	26 semi-circular and circular rock rings, 4 rock rectangles, 38 rock cairns, 4 rock walls, 2 pits, 1 can dump, tin cans, 7 chipping stations: 1 core, 70+ flakes	285000	NE
	feat-56	Chipping stations	3 ccs chipping stations: 1 core, 4 core fragments, 11 flakes	960	
	feat-57	Chipping stations and historic rock alignment	2 chipping stations: 1 ccs test cobble 3 ccs flakes, 60+ rhyolite flakes, English letters formed in rocks at base of cairn, no longer legible.	195	
	feat-58	Chipping stations	2 chipping stations: 3 rhyolite cores, 25 flakes, 1 milky quartz core, 60 flakes	800	
	feat-59	Chipping stations	2 ccs chipping stations: 1 test cobble, 40+ flakes	800	
	feat-60	Chipping station	1 ccs chipping station: 5 test cobbles, 30+ flakes	16	
	feat-61	Chipping stations	5 ccs chipping stations: 2 cores, 45+ flakes	1591	
	feat-62	Chipping stations	2 chipping stations: 1 ccs core, 1 ccs test cobble, 6 flakes, 1 rhyolite core, 7 flakes	940	
	feat-65	Chipping stations	12 chipping stations: 200+ ccs flakes, 7 ccs test cobbles, 1 rhyolite core, 10 rhyolite flakes	17250	
	feat-66	Trail	2 segments of same trail, each 30 m long, separated by 140 m @ 330 degrees		
	feat-67	Chipping station	1 ccs chipping station: 2 test cobbles, 50+ flakes	4	
	feat-68	Chipping station	1 test cobble, 10 flakes	4	
	feat-69	Chipping station and lithic scatter	1 ccs chipping station: 1 ccs core, 3 flakes	4	
	feat-70	Lithic scatter	1 concentration of 20+ ccs flakes	9	
	feat-71	Chipping station	1 ccs chipping station: 1 core, 8 flakes	4	
	feat-72	Chipping station and tool blank	1 ccs chipping station: 2 cores, 100+ flakes, 1 ccs hammerstone, 1 rhyolite biface blank	50	
7377	CG-1	Chipping station	5 rhyolite flakes, 3 ccs flakes	136	NE
7378	CG-14	Chipping station	1 ccs chipping station: 1 core, 22 flakes	252	E

Trinomial (Ca-IMP-)	Field Number	Site Type	Artifacts	Area (M^2)	NR Eval.
7379	CG-15	Cleared circles and chipping stations	2 cleared circles, 2 ccs chipping stations: 6 core fragments, 17 flakes	722	E
7380	CG-16	Chipping stations	2 ccs chipping stations: 2 cores, 7 flakes, light varnish	1456	E
7381	CG-17	Lithic scatter and historic cairn	20 + ccs flakes, heavily varnished, rock cairn with east-west alignment of rocks on either side - miner's claim	72	E
7382	CG-19	Chipping stations, lithic scatter and possible milling feature.	1 possible milling slick on volcanic boulder, 5 ccs chipping stations: 6 cores, 46 flakes, 1 ccs retouched flake	5643	E
7383	CG-26	Chipping stations	4 chipping stations: 5 cores, 50+ flakes	34500	E
7384	CG-27	Chipping stations	3 chipping stations: 1 ccs core, 16 flakes	11250	E
7385	CG-28	Chipping stations	1 ccs chipping station: 3 cores, 100+ flakes	4	E
7386	CG-31	Chipping stations	4 ccs chipping stations: 4 cores, 70+ flakes	4200	E
7387	CG-33	Chipping station	1 rhyolite chipping station: 2 core fragments, 4 flakes	12	E
7388	CG-34	Trail	E-W trending trail of undetermined length		E
7389	CG-35	Chipping stations	3 ccs chipping stations: 2 cores, 40+ flakes	2400	E
7390	CG-36	Chipping stations	8 chipping stations: 6 ccs cores, 3 test cobbles, 100+ ccs flakes, 1 rhyolite core, 4 flakes	5512	E
7391	CG-37	Chipping stations	5 ccs chipping stations: 2 cores, 1 test cobble, 40+ flakes	4160	E
7392	CG-38	Chipping stations	2 ccs chipping stations: 1 core, 12 flakes	12152	E
7393	CG-39	Rock ring/Geoglyph	1 rock encircled rock alignment, indicating south, 60 cm diameter	4	E
7394	CG-41	Chipping station	1 rhyolite chipping station: 50+ flakes	9	E
7395/H	CG-42/H	Historic camp	1 rectangular rock alignment, 2 rock circular alignments, camp fire pits and historic debris	1575	NE
7396	CG-43	Chipping stations	2 ccs chipping stations: 15 flakes, 1 test cobble	36	E
7397	CG-44	Rock ring/Geoglyph	80 cm diameter rock ring encircling embedded volcanic cobble	6	E
7398	CG-45	Chipping stations and cairns	3 ccs chipping stations: 20+ flakes, 1 poss. rock ring, 1 phallic rock cairn, 2 cairns	6750	NE

Trinomial (Ca-IMP-)	Field Number	Site Type	Artifacts	Area (M^2)	NR Eval.
7399	CG-46	Rock rings and chipping stations	2 rock circles, slightly cleared inside, each 2.8 m diameter. 2 ccs chipping stations: 1 core, 30+ flakes	400	E
7400	CG-47	Chipping stations	2 chipping stations: 10 ccs flakes, 1 basalt core, 20 flakes, heavily varnished	1040	E
7401	CG-48	Chipping stations	5 ccs chipping stations: 2 cores, 40+ flakes	7176	E
7402	CG-50	Chipping station	1 ccs chipping station: 1 core, 7 flakes	9	E
7403	CG-51	Lithic scatter	Concentration of ccs lithic: 1 core, 26 flakes, 3 test cobbles	400	E
7404	CG-52	Chipping stations	2 ccs chipping stations: 4 cores, 4 core fragments, 40+ flakes	260	E
7405	CG-53	Chipping stations	4 chipping stations: 1 ccs core, 50+ ccs flakes, 5 rhyolite flakes	2500	E
7406	CG-54	Chipping stations	2 ccs chipping stations: 2 test cobbles, 20+ flakes, 1 rhyolite test cobble	800	E
7407	CG-55	Rock ring (recent historic)	1 rock ring 1.5 m in diameter, embedded in desert pavement, recent artifacts	4	NE
7408	CG-63	Cleared circles and lithic scatter	4 cleared circles, each 2 m. diameter, 12 ccs flakes	980	NE
7409	CG-64	Trail	Trail segment approx. 1 km long, running from major wash to major wash @ 150 degrees		E
7410	CG-74	Pot drop	23 sherds of prehistoric ceramic, 1 rimsherd	8	E
7411	CG-75	Chipping station	1 chipping station with white quartz and ccs: 1 test cobble, 10+ flakes	450	E
7412	CG-76	Trail and trail shrine	1 trail segment 10 m long @ 110 degrees		E
5360T (update)	CG-77	Trail and Chipping station	1 trail segment crossing Indian Pass road, 110 m in length @ 165 degrees, 1 white quartzite chipping station: 100+ flakes, 1 cobble volcanic anvil	4400	E
7413	CG-80	Pot drop and Chipping station	1 milky quartz chipping station: 25+ flakes 5 sherds prehistoric ceramic	300	E
7414	CG-81	Chipping station	1 basalt chipping station: 20+ flake	9	E
7415	CG-85	Chipping stations	2 chipping stations: 1 ccs core, 8 flakes		E
	feat-20			448	
	feat-21	Chipping station	1 rhyolite chipping station: 35 flakes	108	

Trinomial (Ca-IMP-)	Field Number	Site Type	Artifacts	Area (M^2)	NR Eval.
	feat-22	Chipping station	1 ccs chipping station: 9 flakes	48	
	feat-23	Chipping stations	12 ccs chipping stations: 5 cores, 200+ flakes. 1 rhyolite chipping station: 1 core, 2 test cobbles, 100+ flakes, 1 rhyolite core, 2 flakes	11600	
	feat-24	Trail and Chipping station	1 38 m long trail segment, 2 ccs chipping stations: 2 test cobbles, 18 flakes	38	
	feat-25	Chipping station	1 ccs chipping station: 1 core, 13 flakes	100	
	feat-32	Chipping stations	2 ccs chipping stations: 1 core, 10 flakes, all stages of varnish, 4 core fragments, 50+ flakes	984	

KEY:
Recommended National Register Evaluation
E = potentially National Register eligible
NE = not potentially National Register eligible

and four pot drops (totaling 35 sherds), 11 cleared circles, three rock rings, three geoglyphs, and one possible milling slick. Two trail segments within the project area intersect at a point outside project boundaries where a ceremonial/geoglyph complex was recorded. Also documented at four separately defined sites were the rock features and trash scatters from a World War II period encampment associated with the Desert Training Center/California-Arizona Maneuver Area.

Chipping Stations/Lithic Scatters

Chipping stations are comprised of a core and several flakes of the same material. The most heavily used materials were the cryptocrystalline silicates (ccs), widely (and imprecisely) referred to as chalcedonies or cherts. The ccs material in the project area ranged in color from yellow to red to brown to white, and was of variable quality (Figure 3). Other material used were rhyolite, quartz, quartzite, and basalt (Table 2, next page). Some chipping stations encountered did not have a core, but several flakes of the same material in close association with one another. Where the core is missing, it may be an indication that the lithic material was deemed suitable, and that the core was carried off to be worked more thoroughly at a later time. Where the core is present, it could indicate that the material was rejected, or that the desired end product of the reduction was a few large flakes which could be worked into projectiles or other tools.

Of the 49 sites recorded, all but eight had lithic reduction associated with them. A total of 28 were chipping stations or lithic scatters alone, while a total of 13 were chipping stations associated with other features. Some of these sites range over large areas. For example, IMP-5530 (CG-84) stretches for 2 km over the extent of a large Pleistocene ridgeline. It includes more than 50 chipping stations and a light to medium density lithic scatter ranging from one flake/20 m^2 to one flake/three m^2. Also included in this site are two trail segments and several historic features.

Chipping stations ranged from a core with one primary flakes, three secondary flakes and two interior flakes found at IMP-7389(CG-35) to three core fragments with 50 primary flakes, 100 secondary flakes and 50 interior flakes at IMP-7385(CG-28). Clearly it is an over-generalization to say that they never finished tools on the spot, but no finished tools were found in the project area. The overall ratio of primary: secondary: interior flakes is estimated at 27:47:26 (recorded as a percentage of all recorded flakes).

The sheer quantity of lithic prospecting along the desert pavement terraces should not be underestimated. Every pavement surface was probably tested at some point by some member of the aboriginal population. This does not mean that there is a dense scatter of debitage, though, since each test effort may have produced no more than one or two flakes and a test cobble. Later erosional activity further dispersed the remnants of these tests, leading to a vast light or very light density lithic scatter encompassing most of the current project survey area. However, to find and record each flake was seen to be an endless task with limited utility. Instead, we concentrated on defining primary deposition areas where stoneworking definitively took place. Isolated test cobbles (consisting of a cobble with a single flake removed) were also too numerous to record as isolates and were included in the larger lithic scatters.



Figure 3. Photo of chipping station (CA-IMP-7415, Feature 21; view north).



Figure 4. Photo of trail (CA-IMP-5529, Feature 30, view south).

All stages of varnish, or patination, were seen. Most specimens displayed a light to moderate amount of varnish. Site IMP-7390 (CG-36) was unusual in that the chipping stations displayed light varnish, while the surrounding lithic scatter was heavily varnished. This suggests several different time periods of lithic reduction are represented. Some chipping stations, such as IMP-2727 (CG-79) were well embedded in the desert pavement, while other sites, such as IMP-7383 (CG-26) were resting on top of the pavement. This may also be an indicator of time depth, or possible the result of different erosion patterns across the project area.

Table 2. Quantity of Lithics by Material Type and Reduction Stage

	Primary	Secondary	Interior	Core	Blanks and Tools	Total
Cryptocrystalline Silicates (ccs)	811	1397	628	153	5	2994
Quartz	44	102	50	6	0	706
Rhyolite	184	288	220	11	3	300
Basalt	29	49	50	4	0	202
Quartzite	62	105	125	8	0	132
Total	1130	1941	1073	182	8	4334

Trails and Trail Shrines

Ten trail segments were discovered in the project area. Two have been previously recorded. The first one, IMP-5067 runs roughly N-S and parallel to Indian Pass Road. It was recorded by WESTEC in the mid-1980s. They collected several sherds of Colorado Buff Ware in the vicinity of the trail. An additional trail spur was discovered that forks from the main trail toward magnetic east along a low alluvial terrace ridgeline. Three chipping stations of quartz and ccs were also seen near these trails. This trail runs from between 20 m and 40 m off the main Indian Pass Road. For this reason, it has been impacted by off-road vehicles. Since the trail is located in a major wash, there are several sections where all visible traces of the trail have been obliterated by natural erosion.

The other previously recorded trail is IMP-5360T. It runs perpendicular across Indian Pass Road, at a compass bearing of 165°. It was previously recorded by the Imperial Valley College. They labeled this trail by the name "Mojave War Trail," however, Lori Cachora, The Quechan Tribal Historian, could not account for the origin of this name. He remarked that these trails were used

by several different tribal groups, and that such monikers are inaccurate. This trail is discussed in greater detail below with reference to the so-called "Running Man Geoglyph" site.

The longest trail section that we found within the actual project area was IMP-7409 (CG-64), which was approximately 1 km long and ran from one major wash to another, across a series of low alluvial remnant terraces (Figure 4). Its path winds to a certain degree, but basically follows a compass bearing of 150°. This trail runs through sites IMP-5529(CG-86) and IMP-7392 (CG-38). Toward the northern edge of this trail, within the boundaries of IMP-5529 (CG-86), another section of trail forks off to the west and runs for roughly 200 m at 58°. There is a possible trail marker, or trail shrine within IMP-5529 (CG-86), near where the second spur heads off. It is constructed of three rock cairns in a triangular arrangement. Although there are numerous rock cairns within the project area that are attributable to mining claims and other more recent activity, the location of these cairns, at a trail fork and within a concentration of prehistoric activity, suggests a prehistoric association.

Three trail segments were found within the site IMP-5530 (CG-84). This site is on a high Pleistocene formation ridgeline, trending N-S, with many fingers branching off to the east. Two of the trail segments appear to be associated with one another (Feature 66). The northernmost section of this feature follows the main ridgeline N-S and is visible for 30 m. The southern segment is 140 m to the south and heads east along a finger for another 30 m. The third trail segment (Feature 83) is north and east of these. It is actually a Y in the trail, one fork heading at 142° for 30 m, the other branching off near the southern end at 135°. Both segments were obliterated at the southern end by a modern drill pad. A moderate density lithic scatter surrounds the trail.

IMP-7388 (CG-34) is a trail which runs along an E-W trending ridgeline. The length of this trail has not been determined. It runs just south of and parallel to a ridgeline jeep road, at a compass bearing of 270°. It continues at this heading to cross the jeep road. Another fork curves to a heading of 160° to follow the ridgeline. It appears that prehistoric travelers displaced larger cobbles along the route of the trail. No associated artifacts were observed.

Another trail segment, Feature 24 of IMP-7415 (CG-85), was discovered in association with two ccs chipping stations on the remnant terraces south of IMP-5529 (CG-86). It is a 38 m long segment, running at 11°. It is obliterated on the south end by off-road vehicles, and runs into a drainage at the north end.

The remaining two trails are in the wash adjacent to Indian Pass Road. They are located within the 200 m buffer zone surrounding the road to the south of the main project area. IMP-7412 (CG-76) is located on a low alluvial remnant terrace, 50 m to the east of Indian Pass Road. It is visible for 10 m and runs at 110°. There is a circular trail shrine associated with this trail (Figure 5). It is a rock ring, 1.5 m in diameter, constructed of white quartz, white quartzite and cobble volcanics. The entire circle is filled in with similar rocks of various sizes. Although the rocks are not extremely embedded, the presence of white quartz stones in the feature is similar to other geoglyphs recorded in the area (Johnson 1985, von Werlhof 1994). There was no evidence of

charcoal or historic debris associated with this rock feature. IMP-2727 (CG-78) is a 110 m long trail segment which runs along a low terrace overlooking a drainage channel. It runs at a compass heading of 224°. No artifacts were found in association with this trail.

Cleared Circles and Rock Rings

A total of 11 cleared circles were recorded in the project area. These features are frequently interpreted as the archaeological remains of temporary shelters which were constructed of bent wooden poles and thatch (Pendleton 1984). Three of the eleven circles recorded were within IMP-5529 (CG-86), Feature 8. The cleared circles were located on a low terrace at the western edge of the site (Figure 6). These were cleared circles of compact gruss (each 1.5 m diameter), with slight berms around the circumference of each. This site also encompasses 35+ chipping stations, medium density lithic scatter, trail, and trail markers.

Another two cleared circles were located further south, on a remnant terrace along the west side of the major wash in the center of the project area. These were recorded as IMP-7379 (CG-15), and were 2.1 m in diameter. Two ccs chipping stations and a light density lithic scatter were associated with the cleared circles. The remaining four cleared circles were located on a low remnant alluvial terrace in the Indian Pass wash. The site IMP-7408 (CG-63) is 250 m east of Indian Pass Road. The cleared circles were each 2 m in diameter and were accompanied by a light density lithic scatter.

Three rock rings were recorded. Site IMP-7407 (CG-55) was simply a rock ring constructed of cobble volcanics and measuring 1.5 in diameter. One unusual characteristic was that it had been partially filled with alluvial sediments from a nearby slope. This is one of the few rock rings with some potential for subsurface deposits. A small subsurface probe of one quadrant on February 14, 1996 revealed a modern fire hearth containing ash and recent artifacts dating to the 1960s.
Two rock rings of probable prehistoric date were located at IMP-7399 (CG-46). These were tangential to one another, and were aligned roughly N-S on an alluvial terrace next to a wash, and not associated with any trails. Each circle was cleared on the inside and had an interior diameter of 2.8 m. These were associated with 2 ccs chipping stations and a bifacially worked ccs blank within a light density lithic scatter.

A similar internally cleared rock ring was found at IMP-7398 (CG-45). However, this feature was much more disturbed by erosion and deflation. This potential rock ring is associated with three ccs chipping stations, a *lingum* (discussed below), two rock cairns and a light density lithic scatter.

Geoglyphs

Three rock circles, interpreted as geoglyphs, were discovered. A geoglyph at IMP-7382 (CG-19) was comprised of three rocks aligned to magnetic east, encircled by a volcanic cobble ring. The large trail, IMP-7409 (CG-64), is less than 200 m east of this site so no absolute association can be made. Although no certain explanation for this feature can be offered, it seems reasonable to

suggest that the geoglyph served as a direction indicator or a "power circle". This geoglyph was located on a moderately sized remnant terrace in the central wash of the project area.

A second likely "direction marker" or "power circle" was found further south in the same wash (Figure 7). Recorded as IMP-7393 (CG-39), it was a 60 cm diameter rock ring which circumscribed by three small rocks aligned to magnetic south. This circle was constructed of white quartz and quartzite cobbles as well as volcanic cobbles.

Further east, at the bank of the next major drainage, was IMP-7397 (CG-44) (Figure 8). This rock circle was 80 cm in diameter and constructed of the same materials as IMP-7393 (CG-39). Instead of a rock alignment, however, this ring encircled an embedded cobble volcanic boulder and two smaller rocks. Less than 25 percent of the embedded cobble is visible in the center of the rock ring. Rocks of the circle are displaced in two places, creating openings in the ring. It is not known if these openings have symbolic meaning or are the result of later disturbances. The function of this feature remains speculative. Lorey Cachora suggested that the internal rocks may represent topographic features. If this is so, then the feature may also have been created to aid travelers along the many aboriginal trails of this region.

Many piles of rocks were seen within the project area. Most were attributed to recent mining claims, and campers. The one possible exception to this was an unusual phallic rock cairn sometimes referred to as a *lingam*, which was found at IMP-7398 (CG-45). It was made of an unshaped upright cobble volcanic rock, supported by two to three round rocks at its base (Figure 9). These rocks measured from 10 to 40 cm in length. These rocks are atop a larger volcanic boulder. This feature is near a disturbed rock ring and associated with three ccs chipping stations. The site is next to a dirt road and there are also two rock cairns on this site which appear to be more recent mining claims. It would appear that this feature is probably of recent historic date although that cannot be determined with certainty. Several rock cairns within the historic component of IMP-5529 (CG-86) will be discussed below.

Possible Bedrock Milling

A single possible bedrock milling feature was recorded as part of IMP-7382 (CG-19). It was a milling slick or proto-basin on a vesicular volcanic boulder, measuring 1.1 m x 0.8 m x 0.5 m (Figure 10). The slick surface was approximately 15 cm x 10 cm. Close examination of the surface with a 10x power lens shows a smoothed surface but no abrasion marks or evidence of surface pecking or crushing. Milling features are extremely rare in this part of the desert so the identification of the slick remains problematical. It may have resulted from natural erosion but the size and configuration of the boulder is unique. IMP-7382 (CG-19) is located on a moderately sized remnant terrace in the central wash of the project area. The slick was associated with five chipping stations, one flaked stone tool, and a low density lithic scatter but there is no evidence of an intensively used temporary camp.



Figure 5. Photo of trail shrine (CA-IMP-7412, Feature 2, view north)



Figure 6. Photo of cleared circles (CA-IMP-5529, Feature 8, view north)



Figure 7. Photo of geoglyph (CA-IMP-7393, view north).



Figure 8. Photo of geoglyph (CA-IMP-7397, view north).



Figure 9. Photo of stone *lingam* (CA-IMP-7398, view south).

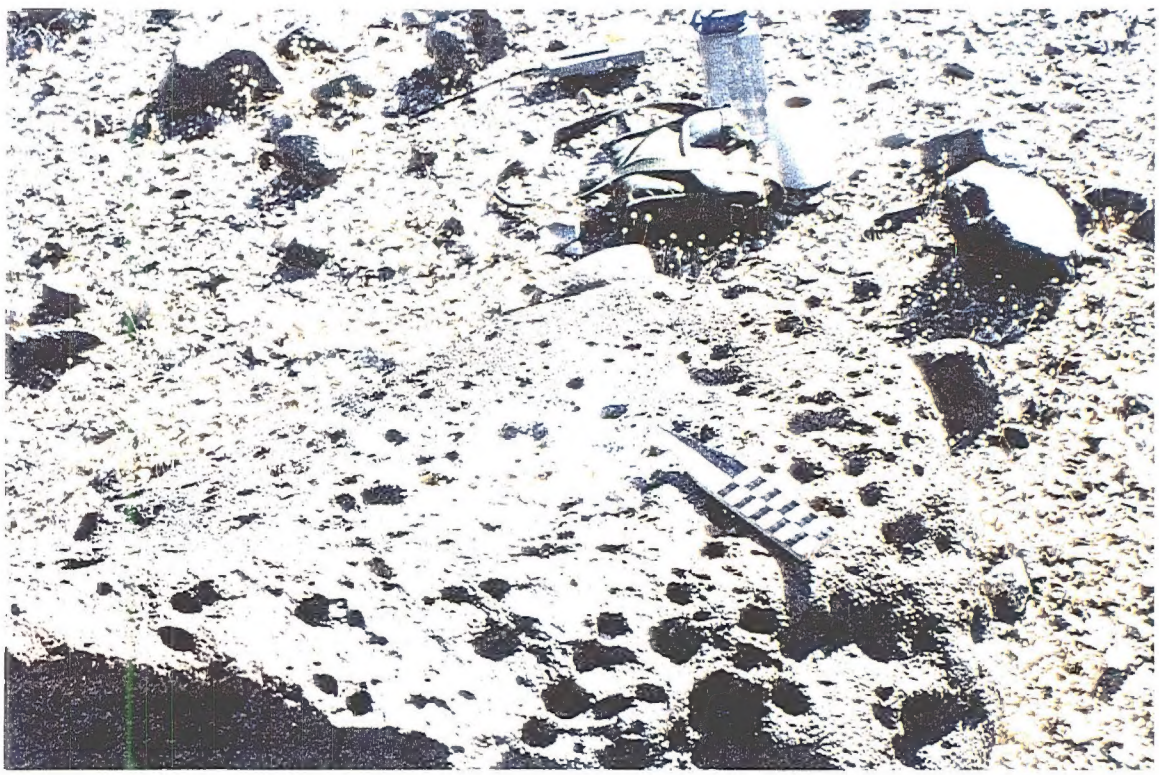


Figure 10. Photo of milling slick (CA-IMP-7382, Feature 1, view northeast).

Pot Drops

Four pot drops of lower Colorado Buffware ceramic were located in the project area. A total of 35 sherds, including one rimsherd were observed. Two of the pot drops were associated with trails, at sites IMP-5529 (CG-86) and IMP-5067 (CG-40). One was associated with a quartz chipping station IMP-7413 (CG-80). The fourth, site number IMP-7410 (CG-74), was an isolated pot drop, approximately 80 m east of Indian Pass Road. This site was located on poorly developed gruss pavement, so any associated trail would have been difficult to identify.

B. Historic Resources

Four historic period sites make up a complex associated with the World War II era Desert Training Center/California-Arizona Maneuver Area (DTC/C-AMA), dating between 1942 and 1944. These sites include CA-IMP-4970H, -5067, -5530, and -7395/H. Each of the sites is described below, beginning with the largest and most complex: CA-IMP-5530. The other sites are probably contemporary outliers.

CA-IMP-5530

The largest site in the complex is at CA-IMP-5530 (Feature 49/H). This is the southern most component of a much larger prehistoric site of chipping stations and low density lithic scatters. The historic camp is bisected by the Imperial Project southern boundary fence. It contains 13 rock rings or collapsed rock rings, 13 rock semi-circles, 38 rock cairns, four rock rectangles, four rock walls, one rock outlined pit, a possible bomb crater or filled pit, and at least one buried field ration can dump.

Few artifacts occur on the surface but include rusted field ration cans, wooden stake fragments and box fragments, and a few wire nails. Significantly, no brass shell casings or machine gun clips were found. The paucity of surface artifacts can be due to several factors. The squad or platoon that used the site were careful to clean the site or bury all trash before they left the site, a common practice. The exercises practiced here also may not have involved live fire. Finally, relic collectors may have removed any expended shells or other artifacts.

All 72 features were assigned shot numbers, precisely mapped with a Sokkia Set 3BII Total Station, and plotted on project topographic maps with AutoCAD and Eaglepoint Coordinate Geometry (Figure 11). Many additional shot numbers were taken to map the roads, washes and other natural features. They show a spatial pattern that differs from previously recorded World War II bivouac sites and that may indicate that special tactical training was undertaken here. Most of the complex occurs on a low alluvial terrace on the north side of a large seasonal wash. The existing dirt track enters the site from a ridge on the northeast and this is probably the route used to access the site during training exercises (Figure 12). A majority of the rock semicircles and rock rings occur in the north end of the site on a desert pavement covered terrace (shots 1-11). Many are still intact and stand 80-100 cm high, composed of local boulders and cobbles crudely

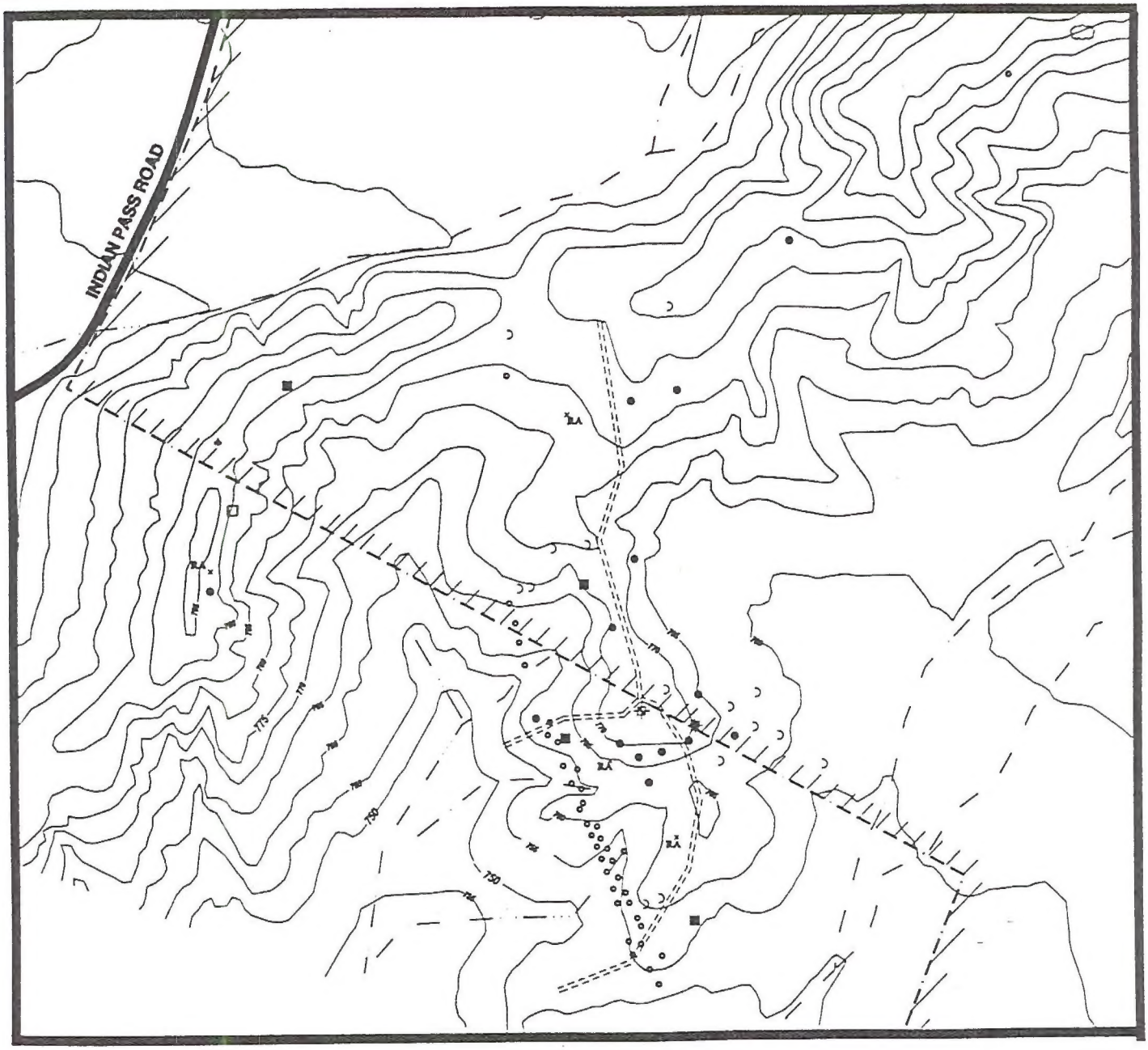


Figure 11.
Map of World War II training site.

stacked up to four courses high (Figure 13). Some of the rock rings have collapsed into cairn-shaped piles, either from deliberate action or natural erosion. In some of these can be seen field ration can or other artifacts. Many of the rings and the smaller semicircles probably represent wind shields and fire rings used to keep warm and heat field rations. In this regard, most of the semicircles open to the south, or southeast, or southwest, possibly indicating the direction of prevailing winds from the north or west (Figure 14).

In addition to the smaller round semicircles are larger more rectilinear semicircles (Figure 15-16). Some of these may have served as windbreaks although there are no obvious tent clearings associated with them. Finally there are four rectangular rock arrangements of indefinite function. All appear too small for tent foundations .

It is also at the north end of the site in proximity to many of the rock rings that the one can dump (Feature 10) was found with the aid of a metal detector and indicated what was being heated at the camp fires. The pit measured 70 by 50 cm and was 30 cm deep. The contents were excavated and all soil sifted to aid in identifying the site. It contained approximately 40 cans, with 36 lids of the same size, each can having a 3¼ in. height and 3 in. diameter. All of these cans are of the double seam, sanitary top fill type with key wind strip opening method. Fortunately, three lids and one body were only partially corroded so both the embossed and printed labels could be read. The printed labels are in red or black ink printed directly on the brass colored exterior finish. The one legible can, with a large "C" embossed on the bottom, reads:

FIELD RATION C
UNIT M-1
MEAT & BEANS
INGREDIENTS: [ ]BEANS (SOAKED), TOMATO PUREE,
[VINE]GAR, SALT, AND SPICES
[ ]ENTS 12 OZ.

US
INSPECTED
AND PASSED BY
DEPARTMENT OF
AGRICULTURE

INSIDE B UNIT CAN



Figure 12. Photo of road leading into World War II training site (CA-IMP-5530, view west).

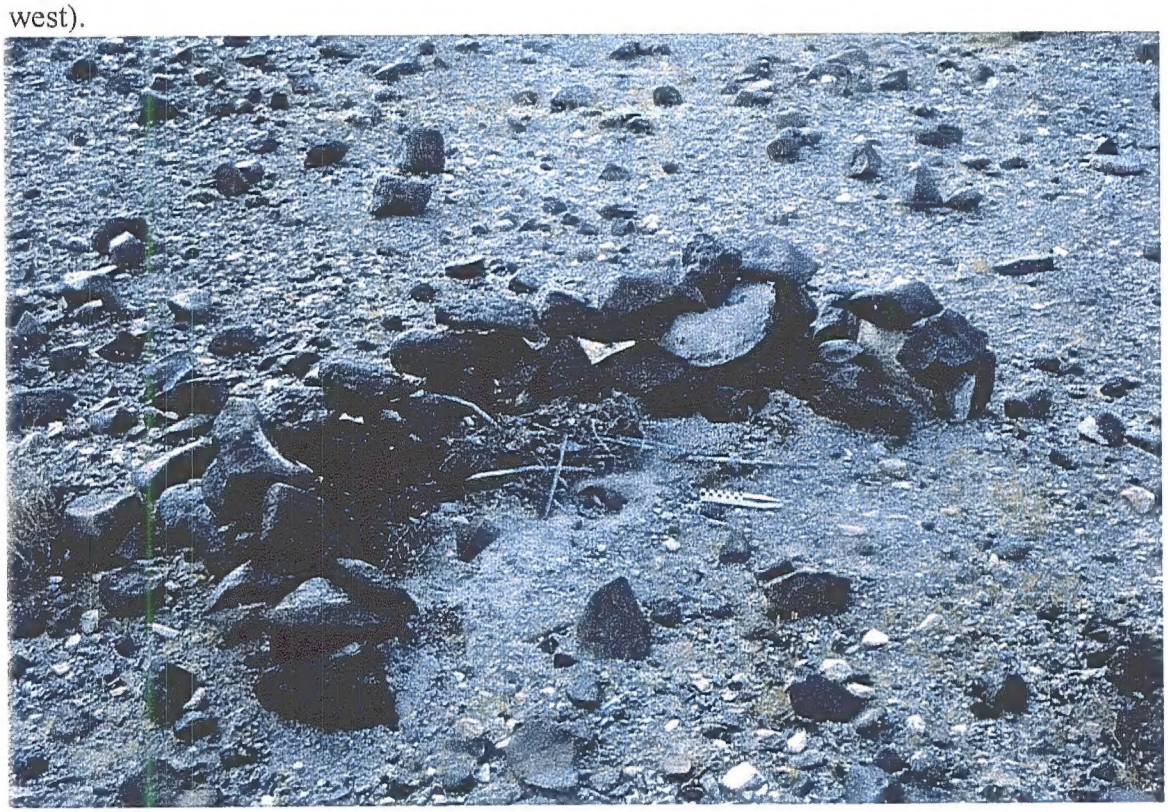


Figure 13. Photo of rock semicircle at CA-IMP-5530, shot 15).



Figure 14. Photo of rock semicircle at CA-IMP-5530 (Feature 49/H view north).



Figure 15. Photo of historic rock ring CA-IMP-5530 (shot 72, view north).



Figure 16. Photo of historic rock ring at CA-IMP-5530 (Shot 99, view west).



Figure 17. Photo of Boulder cairns at CA-IMP-5530.

One printed can lid is also embossed with the code: "KG09F 1242". The last numbers may be a production date of December 1942. The printed label reads:

32 OZS. NET
DOES NOT REQUIRE REFRIGERATION
PRESERVED BUTTER
★ ARMY SPREAD ★
FOR EXPORT ONLY
[ ]sively for the Armed Forces
NOT TO BE RESOLD
FACTORY NO.1 - FIRST DIST. ILL.
KRAFT CHEESE COMPANY
MANUFACTURER, CHICAGO, ILL.

A second printed lid is embossed with the code: "LEMON GC243" possibly indicating a production date of February, 1943. The printed portion reads in part:

U.S. ARMY
FIELD RATION
B [SAVE]
UNIT
BISCUIT CONFECTION
BEVERA[ ]

Only three other cans of a different type were also found in the deposit. Two are small two-piece stamped cans with an internal single friction cylindrical lid that could be replaced after opening. They have a height of only 13/16 in. and a diameter of 2 3/16 in. Such cans were used for instant coffee. The last can is represented by only one preserved base with a larger diameter of 3.5 in.

One of the other enigmatic site features are the 38 stone cairns. Most are well preserved boulder piles reaching a maximum height of over 50-100 cm (Figure 17). Most are arranged in two parallel lines extending over a length of 280 m (924 ft.) at the west end of the site (Figure 18). Individual rocks also appear to have been placed between cairns at the southern end to reinforce the alignment. These cairns appear to mark the site boundary as no features occur further to the west. The cairns may have supported some type of structure or been dummy representations of some other tactical element of the installation.

While most of these features occur at the bottom of a basin shaped terrace, several features that may represent perimeter defenses also occur on the ridge top to the north. Here were found a rock ring, possibly a fire hearth (shot 84), a 4 m. long rock wall paralleling a trail or dirt track that runs along the ridge (shot 85), and a rock-outlined pit or slit trench that may have been a machine gun emplacement (shot 86-87). Further along the ridge to the north is another rock cairn (shot 92), 3-4 courses (80 cm) high with small cobbles arranged at the southern base to spell out

some word or abbreviation (Figure 19). Only the last two letters, "...AS," can be read with certainty. One additional cairn and what appears to be a bomb crater or filled-in pit also occur on the slopes to the south but were not mapped in.

Following the ridge to the northwest corner of the Imperial Project survey area are several other rock outlined spaces that appear to be contemporary based on construction techniques. A previous survey in the project area discovered CA-IMP-4970H (Schaefer and Pallette 1991). Three rock features including two rectangular and one circular structure next to a prehistoric trail. A metal detector survey of the area plus subsurface testing in the interior corner of Feature A, previously interpreted to be a possible hearth, all tests proved negative for artifacts. Further north at the end of the ridge is Historic site IMP-7395/H (CG-42/H). This location provides a 360 degree view which would be ideal for a military lookout post above Indian Pass Road. Rock features include two rock semi-circles that open to the south and two fire rings. Five large cobble volcanic boulders are in a rectangular alignment at the center of the overlook. This area has been cleared of desert pavement. Interlocking seam field ration type tin cans and instant coffee tins similar to those found at CA-IMP-5030, Feature 10, were among the historic debris noted. Finally further north within the prehistoric site, CA-IMP-5067 (CG-40), a well embedded rectangular rock foundation measuring 4 m by 2 m was recorded with the same characteristics as the other World War II period sites. These northern historic sites cannot be proven to be exactly contemporary with the larger complex at CA-IMP-5530, but they do represent a similar, although more carefully built type of installation, perhaps an outlying communication or observation facility. They may also represent a chronologically separate small-scale training exercise.

C. CA-IMP-2727, -5359T, and -5360T: "The Running Man" Geoglyph Site and Associated Trails

Indian Pass Road bisects two previously recorded trails. If these trails are followed some to the south they are found to converge at a site of considerable Native American and archaeological significance. The first trail, CA-IMP-5359T runs northeast-southwest and appears to connect the Imperial Valley/Lake Cahuilla as well as the west side of the Cargo Muchaco Mountains to Pilot Knob with Indian Pass or Black Mesa Wash that lead to the Colorado River. CA-IMP-5360T runs northwest-southeast and apparently passes along the east side of the Cargo Muchacho Mountains northward towards Indian Pass between the Chocolate Mountains and Black Mesa and ultimately to Palo Verde Valley on the Colorado River (Unpublished map by William C. Allen, c. 1961, San Diego Museum of Man). Both trails are heavily incised into the desert pavement and can be continuously traced for several kilometers. During the thousands of years of their use, most of the large stones have been removed from their path where they cross boulder strewn desert pavements (Figures 20-21). These are some of the most heavily incised trails with some of the highest associated artifact concentrations to be found in this part of the desert. Several pottery scatters were mapped along the trails and additional lithic material was also noted, much of which is heavily varnished and may date as far back as the Paleoindian period. Observed pottery types along the CA-5359T trail included Colorado Beige (Patayan I), Tumco Buff (Patayan II), and Parker Buff (Patayan II-III). These types would be expected for a trail used both before and during the Late Holocene infilling of Lake Cahuilla.



Figure 18. Photo of row of cairns at CA-IMP-5530 (view southwest from shot 34).



Figure 19. Photo of rock alignment next to cairn at CA-IMP-5530 (shot 92).



Figure 20. Photo of portion of trail (CA-IMP-5590T) as it run through CA-IMP-2727 (view northeast).



Figure 21. Photo of portion of trail (CA-IMP-5360T) as it runs through CA-IMP-2727 (view southwest).

The two trails intersect on a desert pavement covered terrace that is circumscribed by washes. On this terrace is a remarkable site, CA-IMP-2727, with significance for Native American religion and archaeological interpretation of prehistoric travel, land use, and ceremonialism. An extensive complex of pot drops, lithic remains, rock rings, cairns, and rock alignments indicate that this intersection was the scene of much human activity including symbolic and ceremonial behavior.

A total of 15 features were identified, described, photographed, and precisely mapped with a Total Station (Figures 22-23). A low density lithic and ceramic scatter was found to extend throughout the terrace and extending out for an indeterminate distance. Malcolm Rogers (below) collected many pot drops and sherd samples along these trails and it is likely that surface collections were made at the site. The information collected during this survey was used to prepare a supplemental State Parks and Recreation archaeological record (Volume II). Each of the recorded features is described below.

Feature 1: "The Running Man Geoglyph"

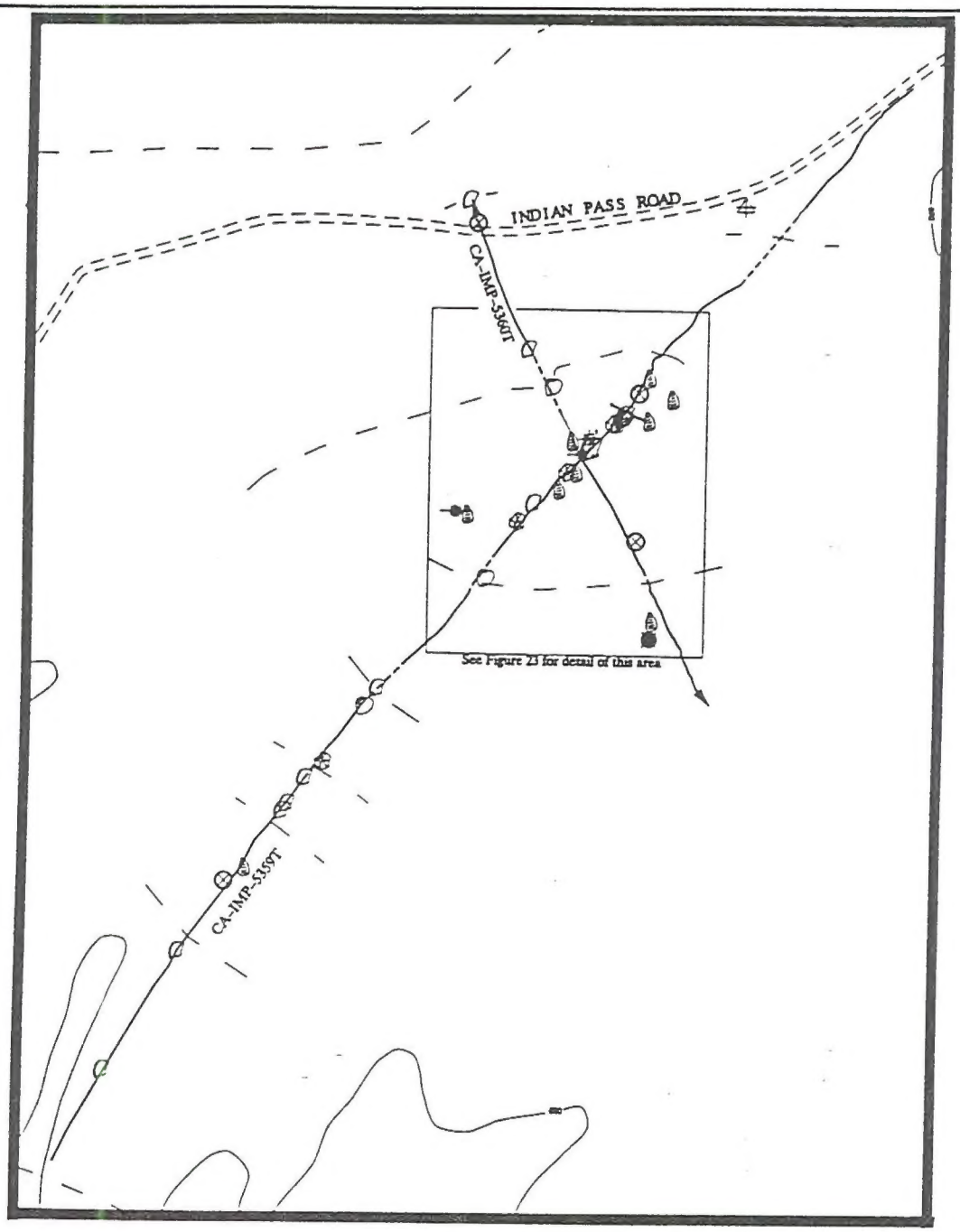
A boulder and cobble geoglyph in the form of a running human figure is located at the northeast quadrant of the intersection of the two trails (Figure 24). It is oriented with the head to the south and facing east. A total of 33 heavily varnished stones in a 2 m by 1.4 m area make up the geoglyph. One additional unvarnished quartz rock lies at the "face". No caliche occurs on the tops of the rocks although some may be detected on the sides of the first rock of the back leg and the fifth and sixth rocks of the front leg. The rocks rest directly on the desert pavement and are not embedded. Two quartz flakes occur near the center of the geoglyph and an additional small quartz stone occurs above the head that may be natural. The fact that Malcolm Rogers did not mention or map the geoglyph when he recorded this site in 1939 (discussed below), and the lack of embeddedness of the geoglyph suggest that this may be a very recent historic addition to the site.

Feature 2: Rock Alignment

This 2 m long north-south oriented alignment of 15 heavily varnished rocks also contains two pieces of quartz near the center (Figure 25). It is located just north of the Black Mesa Trail (CA-IMP-5359T) and east of "The Running Man" geoglyph. All of the stones are heavily varnished and it lies above the desert pavement.

Feature 3: Rock Alignment

A very large 36 m long rock alignment is oriented north-south and bisects the so-called "Black Mesa Trail" (CA-IMP-5359T). The boulders and cobbles are heavily varnished, slightly embedded in the desert pavement, and arranged in a long, slightly wavy line (Figure 27). The eighth stone north of the trail is a large unvarnished quartz boulder and is the only piece of quartz in the alignment. Malcolm Rogers and others have interpreted the alignment as a "spirit break" for the purpose of impeding the passage of harmful spirits along the trail (Rogers 1966:51). Rogers inferred that these features are most common where Patayan (Yuman) period trails cross



L E G E N D

- Trail
- Trail Inferred (obliterated by fluvial processes)
- Wash
- Site Datum
- Survey Control Monument (N91,638.58 E90,711.83)
- Rock Cairn
- Rock Circle
- Geoglyph
- Core
- Rock Alignment
- Pottery Scatter
- Chipping Station

NORTH

225 0 225 550
meters

Figure 22.
Map of intersecting trails (CA–IMP–5359T, 5360T) and geoglyph site CA–IMP–2727.

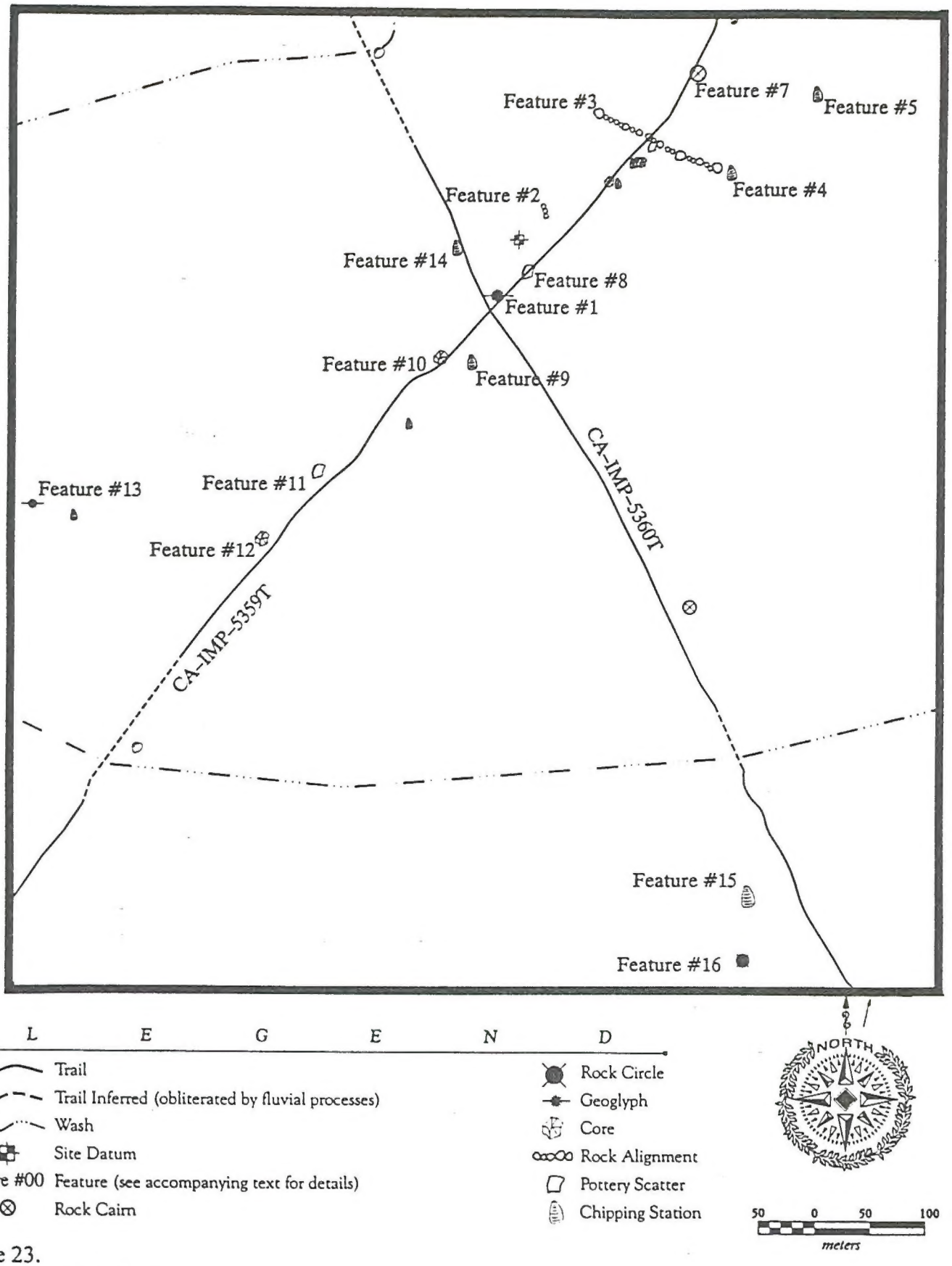


Figure 23.
Map of CA–IMP–2727.



Figure 24
Photo of the "Running Man Geoglyph" may be a recent addition to CA-IMP-2727.



Figure 25 Photo of small rock alignment (Feature 2) at CA-IMP-2727.

over a Paleoindian period (San Dieguito) trail. Like the other features, it may certainly have deeper and more esoteric meanings as well.

Feature 4: Chipping Station

More than 11 pink quartzite flakes, one quartzite core, and a milky quartz hammerstone are scattered over a 60 cm by 80 cm area.

Feature 5: Chipping Station

Over 40 milky quartz flakes, two chalcedony flakes , and four quartz cores are scattered over a 1 m by 1 m area. There is much fractured quartz in the surrounding area that may also be broken. A second possible chipping station is located 6 m to the south. Quartz was not only used for making utilitarian tools but was also broken for spiritual purposes (Altshul and Ezzo 1994; Schaefer 1985b). Broken quartz is often associated with geoglyphs where it can be used as a coloring element such as at Pilot Knob or as an independent feature (Schaefer 1985b). One interpretation is that the quartz holds power that can be released by breaking it. This may have been an activity associated with visiting sacred places. For example, quartz chipping stations are particularly common near the geoglyphs of Pilot Knob. They may also occur along trails as a visible night time trail marker.

Feature 6: Rock Ring

A loosely arranged rectangular rock alignment of heavily varnished boulders and cobbles measures 2.4 m (east-west) by 1.8 m (north-south) and opens to the southeast. It is made up of 27 rocks that lie just above or are slightly embedded in the pavement.

Feature 7: Rock Cairn

This pile of boulders (1.2 m by 0.8 m) is located on the north side of the trail some 30 m east from the large rock alignment (Figure 27). This feature was recorded by Malcolm Rogers in 1939 and interpreted to be a trail shrine. Today, many of the boulders exhibit caliche on the upper surfaces, likely a result of recent historic displacement of the stones.

Feature 8: Pottery Scatter

Five ceramic sherds are located on trail CA-IMP-5359T, approximately 17 m northeast of the intersection of the two trails. They are made from a fine paste with a small amount of small rounded quartz temper. A burnished red slip indicates this is Colorado Red, a Patayan I (A.D. 700-1000) type found elsewhere along Indian Pass (Waters 1982b:562).



Figure 26. Photo of the 36 meter long rock alignment (Feature 3) at CA-IMP-2727 may be a "spirit break".



Figure 27. Photo of disturbed rock cairn (Feature 7) at CA-IMP-2727 may be a trail shrine.

Feature 9: Chipping Station

A 1 m by 2 m scatter of more than 26 milky quartz angular lithic debris may have been used for either utilitarian or ritual purposes.

Feature 10: Large Core and Flake

A large rhyolite core and one associated flake are located just north of the trail CA-IMP-5360T.

Feature 11: Pottery Scatter

Three sherds of Hedges Buff are located on CA-IMP-5360T. This sherd tempered type (Schaefer 1994b) is typical of Patayan III period (A.D. 1600-1930) Quechan production.

Feature 12: Rhyolite Core

A rhyolite unifacial core probably represents a discarded blank. One side still retains most of the cortex.

Feature 13: Recent Quartz Geoglyph

A recent historic geoglyph is located on the next terrace to the west of the main concentration and north of the trail, CA-IMP-5360T. It measures 4.3 m by 1.6 m and apparently spells out a name or phrase beginning with the letter "J". The cobbles lie directly on the desert pavement. This feature was also not recorded by Malcolm Rogers in 1939 and it is most certainly of recent origin.

Feature 14: Chipping Station

A small milky quartz chipping station measures 50 by 50 cm and contains more than 20 pieces of angular debris and one or more core fragments. Such chipping stations may be for either utilitarian or religious functions.

Feature 15: Chipping Station

A scatter of chalcedony debitage in a 50 cm by 100 cm area. Included are two unidirectional cores, and at least twelve flakes (4 primary, 4 secondary, 4 tertiary, 1 shatter) from two different sources.

Feature 16: Rock Ring

A cleared circled surrounded by a discontinuous rock ring of heavily varnished boulders and cobbles is located south of the terrace and adjacent to trail Ca-IMP-5360T. The feature measures 2 m (north-south) by 3 m (east-west) with an openings to the west and east.

Malcolm Rogers at C-70, and the Authenticity of the "Running Man" Geoglyph

In 1939 and again in 1941 and 1942, Malcolm Rogers of the San Diego Museum of Man visited the site and made observations that are important to interpreting the history and function of the various features. He made entries in his field notebook, drew a detailed sketch map at the intersection of the two trails (Figure 28), designated C-70A and C-70B, took photographs, and collected numerous ceramic samples along many parts of the trail. Rogers' surface collection includes 13 boxes or lots of sherds, a ceramic scoop, five scrapers, one metate, and a stone spokeshave (San Diego Museum of Man locations 2-295, 2-296) . These activities were part of a larger effort to record sites and trails throughout the area. His photos (San Diego Museum of Man, Roll No. 7, Neg. Nos. 22-24a, 24b). include east and west views of the major rock alignment, a cairn, and a view of a portion of the trail going through the desert pavement. A photo of the trail and largest rock alignment were later published in the posthumous release of his synthesis of southern California archaeology (Rogers 1966: 47). A transcription of his original field notes include the following description:

> C-70 - Ceremonial Hill at junction of Black Mesa Trail and the ~~Outer Colorado Trail~~ Mohave Trail [Rogers' cross-out].
>
> As the Black Mesa Trail climbs up onto this malpais mesa which covers about 5 acres, two small trail shrines occur. They are on the east side. No. 1 the lower one is in a fork of the trail and has one scummed pink ware olla smashed in it. No. 2 which is 40 ft above it is on the south side of trail and had only a few red ware sherds in it. Sherds are plentiful on both sides of trail at this point. Going west at the margin of the mesa the trail passes through an alignment of lava boulders spread about one foot apart.
>
> This number includes all the pottery on the Branch A of the Black Mesa=Delta Trail from where the Delta Trail is lost in the western wash alluvial back to C-70 and as far as the Black Mesa Road (72) broken ollas were found.
>
> C-70-D
>
> Black Mesa branch B trail to the Delta - 9 pieces of pottery on this trail-low number accounted for because the trail is mostly over wash land and much of it has been obliterated.
>
> C-70-A= 34 ceramic vessels found to date Oct. 1939
> 15 " " on north section 1941
>
> C-70-C All San Dieguito Phase I area from B Mesa Wash north to C-4 area. This area lies all along the southwest side of Black Mesa, Some of the Boulder ruined house sites here are quite often 16' to 18' in diameter. There are many SD trails crossing this area toward the Algodones San Dunes.

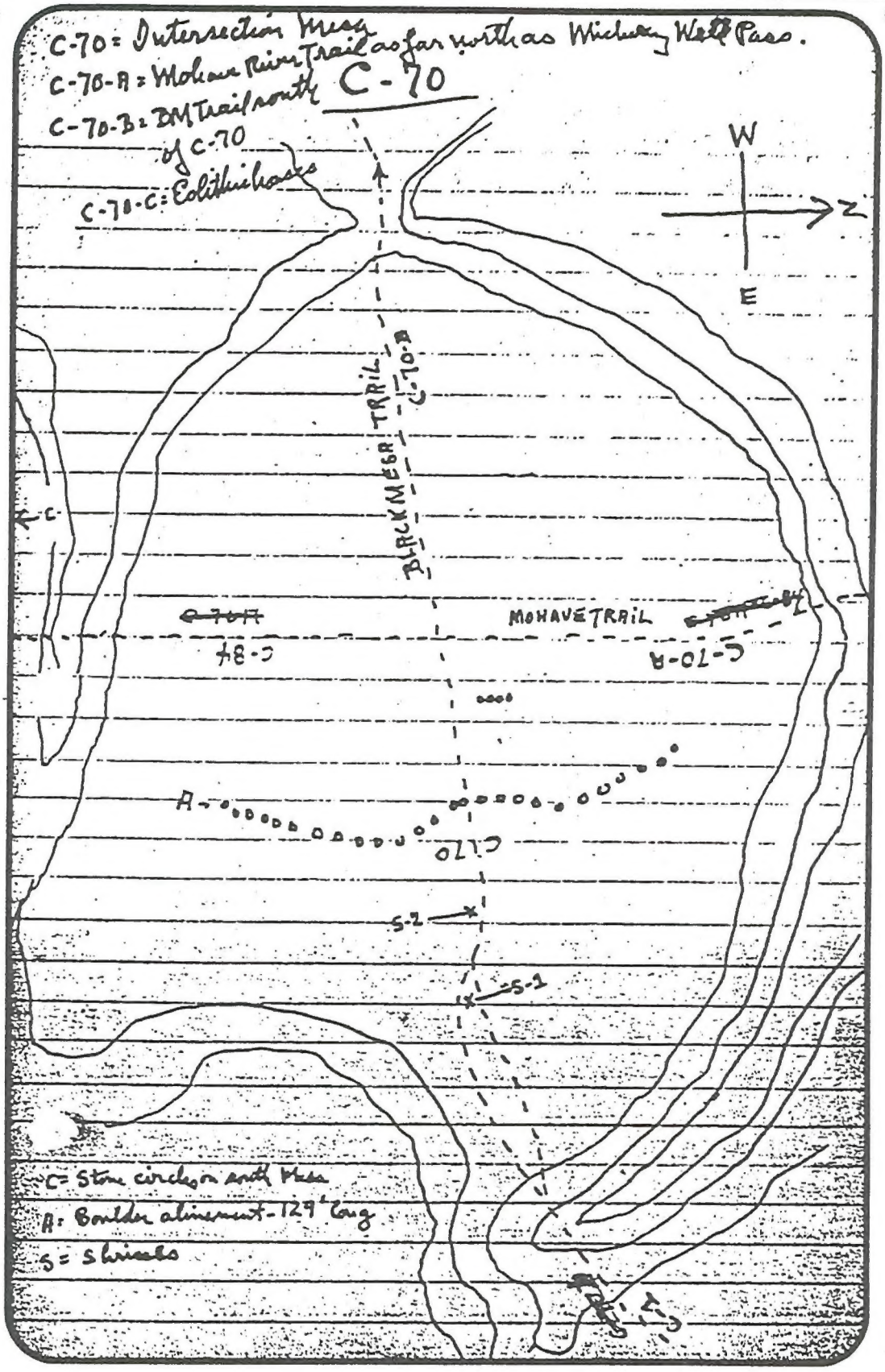


Figure 28.
Malcom Rogers' 1939 map of CA–IMP–2727 (San Diego Museum of Man).

1942= 16 additional broken pots found on C-70-A

(Malcolm Rogers' unpublished field notebook on file, San Diego Museum of Man, page 88-90) .

Later site records at the Museum of Man describe much of the lithic material and rock rings as San Dieguito I (early Paleoindian period). Unoxidized flakes and Yuman II and II pottery are also noted with Hohokam ceramics from Arizona on the C-1 trail in the C-70 area, i.e. Indian Pass. Glendale Corrugated pottery is mentioned on the south end of the C-70-A trail which is designated C-84-S. The rock alignments are interpreted as devises to block the spirits of the C-1 trail users. The Yuman I trail is interpreted as a later intrusion over the older SD I trail: "About the beginning of the Yuman II period the war trail from Mohave country to Yuma was laid over it and used until the eighteen hundreds". Flakes and ceramics occur to a distance of 30 m from the trail and date to this period. The notes go on to say: "Elderly prospectors and natives of Yuma have told me that they had seen Yuman woman out in this region collecting palo verde seeds and other seeds as late as 1890". The absence of Yuman III sherds suggested that late period camping was infrequent, however. Much older trails are distinguished by their faint traces, varnished pebbles on the trails, lack of parallelism with Yuman trails, and absence of any obvious direction toward water sources (Unpublished site records, San Diego Museum of Man).

Clearly Rogers never mentions the "Running Man" geoglyph, thus calling into question its authenticity as an ancient or even Native American feature. It is extremely unlikely that Rogers would not have recorded this feature had it been present. It lies directly at the intersection of the two major trails and he recorded many of the other major features, including a small rock alignment that is next to the now present geoglyph. Rogers had over ten years experience in the Colorado Desert by the time he recorded this site and his field notes and maps prove him to be a careful observer. In November 1981, Bob Begole made notes in the Museum of Man records files on the site. He drew in the location of the geoglyph on a copy of Rogers' map and commented: "Either Rogers missed this ground figure or it is not as old as the deep orange ground stain on the cobbles would suggest". I suspect that the latter is correct since Rogers was a meticulous observer and such an impressive geoglyph would have been impossible to overlook, especially since he spent much time walking the trails looking for pot drops and other diagnostic artifacts. I must therefore conclude that the "Running Man" geoglyph is probably a recent fabrication that was placed here after 1941. In support of this interpretation is another geoglyph at the site made entirely of milky quartz fragments. It is located only a short distance from the "Running Man" and originally spelled someone's name or another message beginning with a "J". It lies above the pavement just as the "Running Man" and is certainly of recent historic date. In any case, the fabricator of the "Running Man" geoglyph appeared to be careful to place the stones with the red ground patina and caliche deposits mostly bottom down.

The style of the geoglyphs also creates doubt about its authenticity. Most rock alignment type geoglyphs tend to linear forms (von Werlhof 1987) like the two examples at CA-IMP-2727 that are undoubtedly genuine. When human figures are shown they tend to be portrayed in a geometric stick style (Johnson 1985:172). The "Running Man" geoglyphs would therefore be a

unique naturalistic action figure that is not represented anywhere else. Johnson (1985:171), however, includes it in his inventory without critical evaluation. More naturalistic action figures are found in the giant intaglio style whereby desert pavement is removed to produce a negative image, with the most famous examples being the "Dancing Shaman" and (suspect)"Fisherman" geoglyphs (Johnson 1985:32). (The "Fisherman" geoglyphs also needs further critical scrutiny because it is so atypical). It is the fact that Rogers did not record the "Running Man" in the late 1930s that is the most convincing argument for a recent date.

VI. EVALUATION AND RECOMMENDATIONS

A. Significance Evaluation Criteria

Regulations that govern the Section 106 review process are stipulated in 36 CFR Part 800 ("Protection of Historic Properties"). These regulations specify that the Federal agency consult with the State Historic Preservation Officer (SHPO) on determining if a property is eligible for the National Register of Historic Places (36 CFR 800.4). The criteria for determining eligibility revolve around evaluating the "significance" of the property, stated as:

> The quality of significance in American history, architecture, archeology, engineering, and culture is present in districts, sites, buildings, structures, and objects that possess integrity of location, design, setting, materials, workmanship, feeling and association and:
>
> A. That are associated with events that have made a significant contribution to the broad patterns of our history; or
>
> B. That are associated with the lives of persons significant in our past; or
>
> C. That embody the distinctive characteristics or a type, period, method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; or
>
> D. That have yielded, or may be likely to yield, information important in prehistory or history (36 CFR 60.4).

Over the years, the National Park Service has provided further guidance for applying National Register criteria and these have also been used. The property in question must be at least 50 years old and bear integrity of setting, feeling, and workmanship. Aspects of Native American heritage values are also a major consideration which require consideration of certain sites under criterion "A". As archaeological sites, all of the Chemgold Project prehistoric sites are appropriately considered under criterion "D" for scientific significance. The historic sites may be considered under criteria "A", "B", and "D".

Section K of CEQA outlines the procedures for the inventory and evaluation of "importance" of cultural resources. These criteria for "importance" include age, integrity, "uniqueness", historical significance, and scientific research values. These criteria are similar to federal NHPA specifications although they have not been as fully articulated in support literature as those provided by the National Park Service.

An important archaeological resources is specifically identified in Appendix K as one which:

A. Is associated with an event or person of:

1. Recognized significance in California or American History, or
2. Recognized scientific importance in prehistory.

B. Can provide information which is both of demonstrable public interest and useful in addressing scientifically consequential and reasonable or archaeological research questions;

C. Has a special or particular quality such as oldest, best example, largest, or last surviving example of its kind;

D. Is at least 100 years old and possesses substantial stratigraphic integrity; or

E. Involves important research questions that historical research has shown can be answered only with archaeological methods.

B. Native American Significance

This discussion of Native American significance is based on previously published literature and provides only a preliminary overview of what have been general approaches and traditional perspectives on cultural resources previously taken by the Yuman peoples of the Lower Colorado River. More current and specific information on the project area and its cultural resources must await consultation with the Quechan Nation, the people most closely linked by history and geography to the project area.

For the traditional Yumans of the Colorado River, religion and world view guide their approach to the significance of cultural resources (Baksh 1994). It is difficult to faithfully portray the complexity and esoteric nature or Yuman spirituality because it is a dynamic belief system in which dreaming, adherence to traditional learning, personal experiences, and varying patterns of acculturation effect its expression. This world view stresses the interconnection of daily life with religion, unlike western industrial society where the sacred and secular are more clearly segregated. The secular world exists concurrently with the spiritual world for the traditional Yumans, and the latter can be experienced through dreams, vision quests, song cycles, the telling of the creation narrative, and oral traditions (Kroeber 1925). So too does the prehistoric and historic past exist as a continuum with the present, as all things harken back to the creation.

History is retold in the oral traditions of the Yuman peoples and in fact, prehistory and history are considered indistinguishable. Therefore the archaeological remains are interpreted with multiple layers of meaning that integrate spiritual values and oral traditions. Some of these

interpretations coincide with the paradigms of scientific archaeology and some do not. In either case, the Yuman oral tradition and interpretive approach add important insights to the otherwise materialist academic approach (Anyon et al. 1996).

The consideration of prehistoric sited under criterion "A" can cause some dilemmas for agency implementation of the Section 106 process because the criteria for significance evaluation (36 CFR 60.4) appear to delegate most prehistoric sites for consideration under criterion "D" alone (scientific or historical information) while historic sites (i.e. dating after the beginning of written accounts) are considered under "A" through "C" (historic events, patterns, people, and architecture) as well as "D" (information). The methods and inherent administrative problems in considering prehistoric sites under criterion "A" has recently been raised and a constructive dialogue has resulted (Anyon 1995; Anyon, et al.1996; Dongoske et al.1995; Ferguson et al.1995a, 1995b; King and Phillips, Jr. 1996; Sebastian, 1995). Whatever position is taken, the end result is the need for close consultation and cooperation between concerned Native American groups, government agencies, and SHPOs for the evaluation and treatment of cultural resources as new approaches are developed.

While the evaluative criteria of 36 CFR 60.4 are appropriate for historic sites, they provide little guidance for traditional cultural properties such as the prehistoric trails within the project area, or more importantly, natural landmarks or sites with religious or traditional cultural values. To rectify that situation, Patricia Parker and Thomas King (1992) recently provided specific guidance for evaluating traditional cultural properties under criterion "A". They write :

> The association of a property with significant events, and its existence at the time the events took place, must be documented through accepted means of historical research. The means of research normally employed with respect to traditional cultural properties include ethnographic, ethnohistorical, and folklore studies, as well as historical and archaeological research.

In their discussions, Parker and King expand the definition of "historical" to include traditional cultures and traditional oral history, and "events" to include either a moment in history, events reflecting a broad pattern or theme, or an event or period in the mythological past. With regard to the mythological past, even natural landmarks such as a mountain peak could be included under Criterion "A" if it is identified in orally transmitted narratives.

Yuman attitudes towards cultural resources may be characterized as emphasizing conservation and preservation. This is particularly true of ceremonial sites such as geoglyphs, certain trails, rock art, burials, and natural landmarks that figure in the religion and oral traditions. This view has been officially expressed in the past by CRIT (Lamb 1981) and the Quechan Nation (Quechan Indian Tribe 1989) tribal council resolutions. Perhaps the clearest statement in this regard is provided by Mr. Lorey Cachora, a very knowledgeable and widely respected Quechan elder who has participated in many CRM projects in the lower Colorado River area. He said:

> Tribal oral histories can be as significant as written records of the "truth." Even though tribal histories written by some non-Indian people have been good, many have been written from a biased point of view. There have been far too many one-sided accounts of events involving Indian people and tribes. Based on this, there is a tremendous need for the traditional history to be told. Today many of us, as Native Americans, feel that our rights have been conspicuously violated in the past. We have seen projects that have gone through our traditional territory, and even our contemporary lands, without regard for our heritage. The continued destruction of cultural resources associated with our past/present intrudes on many of our traditional activities. These include social and religious practices, along with the gathering of vegetables, food, medicinal herbs, and natural resources important to our technology...
>
> So the mountains along the Colorado River region are highly significant in regional Native American cultural and ethnic identity. Spiritual activities and events are deeply associated with numerous intaglios, petroglyphs, trails, lithic scatters, and cleared circles present along the Colorado River and surrounding hills.
>
> Today we fear that disturbance of this area or any area would result in the destruction of this aspect of traditional culture and religion. As a physical feature and a spiritual cornerstone, some sites cannot be replaced or relocated. Sites are often indistinguishable from the land by the untrained eye or those unfamiliar with regional Native American culture. Any damage, once done, can never be undone. In order to avoid heavy-handedness, it might be pointed out that some cultural resources have been there since creation, according to Quechan beliefs, and the songs in the mountain will last forever as well. This is a very long time to regret a thoughtless act (Cachora 1994:13-14).

Cachora expresses a point of view similar to other southwestern tribal groups that a wide range of cultural resources are significant (Dongoske et al.1995; Ferguson et al.1995a, 1995b) and that specific Native American consultation is necessary to identify them. Pending this consultation, we have endeavored to evaluate the sites for Native American values as consistently and objectively as possible. Following the guidelines of Parker and King (1992) Native American significance has been attributed to any sites associated with trails, travel, ceremonial activities, geoglyphs, and rock art, or where specific oral traditions can be identified. Given that unpublished oral traditions may be found to exist for the Indian Pass area, additional Native American values may therefore be identified through future consultation.

C. Evaluation Results

Chipping Stations

The complex of chipping stations and lithic scatters in the Imperial Project area are evaluated as significant under criterion "D" because they have the potential to yield additional information on the exploitation of local lithic resources for stone tool production. A data recovery approach

involving sampling of the lithic material is proposed in the Management Recommendations section below to mitigate impacts.

The largest portion of sites within the project area are lithic reduction areas, or chipping stations. A total of 194 individual lithic reduction events were recorded during this study, of which all but three occur in the direct impact area of the project. Given the limitations of field surveys as a sampling method, these 194 chipping stations may be seen as a large proportion of an even larger lithic reduction assemblage. To understand the density of prospecting seen here, it must be remembered that the survey area was a major prehistoric travel corridor. The available siliceous and volcanic raw materials found on the many desert pavement-covered terraces made lithic procurement and cobble testing a logical and efficient embedded resource collection strategy.

These low density lithic scatters and chipping station concentrations are not restricted to the survey area, but occur wherever there appears to be usable lithic sources, particularly the older and elevated Pleistocene alluvial terraces. A number of lithic exploitation areas were previously investigated for the Mesquite Mine Project (Schaefer 1987; Shackley 1988). A similar range of lithic source materials were found and it is likely that the range of flake types is also similar. It remains to be demonstrated if differences exist in regards to age, relative frequency of lithic sources material, or spatial distribution. The Mesquite lithic scatters are also located adjacent to a major trail system that connects the Colorado River with the Salton Trough, as well as serving as part of an off-river north-south route for trade and warfare. In fact, the Indian Pass trail system appears to be directly linked to one of the same north-south trails as the trail found running through the Mesquite Mine area.

Each chipping station in the survey area, by itself, may provide only limited data. These stations typically are not accompanied by temporally diagnostic artifacts, but rather represent raw material reduction as it would have been undertaken by any stone-tool using culture. Additionally, a number of researchers have already successfully undertaken quantitative analyses of desert lithic procurement in this area, demonstrating their significance under Criterion "D" (Pendleton 1984, Bamforth 1992, Schaefer 1987, Shackley 1988). An individual chipping station, therefore, represents repetitive data, and cannot be considered significant. However, the entire complex of chipping stations and lithic scatters is significant as a large-scale resource collection area, within which statistical analysis may be able to identify meaningful patterns. A collection area of this nature has the potential to address questions concerning embedded procurement strategies, hunter-gatherer mobility and prehistoric lithic technology.

Cleared Circles

Previous research has demonstrated that cleared circles do not have subsurface components (Schaefer 1987). No additional information can be gleaned from the cleared circles beyond what has already been recorded in the survey and they are evaluated as not eligible for the National Register. No further work is recommended.

Eleven cleared circles were found. All were clustered and located adjacent to major washes such the three circles at CA-IMP-5529, the two circles at CA-IMP-7379, the two clear circles with rock rings at CA-IMP-7399, and the four circles at CA-IMP-7408. This clustering is consistent with the San Dieguito pattern defined by Rogers (1928, 1938, 1939). The presence of cleared circles is suggestive of some temporary camps, and as such, show that travelers did occasionally stop along the trails to sleep (especially IMP-5529), or to make expedient use of local plant and animal resources, however sparse, or to exploit lithic resources. These finds may help to confirm Pendleton's behavioral assumption No. 4 for Colorado Desert settlement patterns; that chipping stations outside of the daily foraging radius of the Colorado River (estimated at 10 km) will be in proximity to a temporary camp of some sort (Pendleton 1984:133). The small number of cleared circles and rock rings in proportion to the enormity of lithic scatters suggests considerable exploitation by non-resident populations.

Rock Rings

Only one rock site, CA-IMP-7399, is associated with an artifact scatter and therefore has some potential to address questions of site function and chronology. The other rock ring sites either occur as isolated features without the potential to provide additional information beyond the inventory phase or are of proven recent date. One of the three rock ring sites is therefore evaluated as National Register eligible.

Larger rock rings are interpreted to be foundations for temporary brush shelters. In that regard they are functionally similar to cleared circles. Indeed all of the rock rings have cleared interiors. Rarely do such features have subsurface components or provide additional information beyond what can be recorded on the surface.

In regards to CA-IMP-7399, the two adjacent rock rings are associated with two chipping stations, a discarded stone blank or core, and a low density lithic scatter. Although the contemporaneity of all the features cannot be established this site may be a small temporary camp. Due to the association of features and potential contribution to the understanding of lithic procurement patterns, it is considered significant under criterion "D".

The one rock ring at CA-IMP-7398 is not well preserved and is found next to a dirt road and in the vicinity of extensive recent historic disturbance. It is therefore evaluated as not significant.

One potential exception was CA-IMP-7407, a large rock ring that has become partially buried by alluvial deposition and down slope erosion. A small subsurface probe of one quadrant on February 14, 1996 revealed a modern fire hearth containing ash and recent artifacts dating to the 1960s. This feature is therefore evaluated as not significant and the original site form was so amended.

Trails

All of the trails and associated features within the survey area are evaluated as National Register eligible under both criteria "A" and "D" because of their historic associations with the Quechan and early Spanish exploration, and their potential to address research issues concerning prehistoric mobility and travel through Indian Pass.

The trails and associated features in the project area are part of one of the more important east-west and north-south prehistoric transportation networks in the region. These include CA-IMP--5067, -5359T, -5360T, -5529, -5530, -7388, -7409, -7412 ,and -7415, The complex remains only partially known from ethnohistoric sources but it contains substantial archaeological confirmation as a major transportation route. The trail network also has substantial Native American significance. Portions of the Indian Pass route (CA-IMP-1811, -4970H, -5067) have been investigated by von Werlhof (1984) and Schaefer and Pallette (1991). von Werlhof (1984:49) reported one of the largest petroglyph concentrations in southeastern California at the summit of Indian Pass, more than 2 km northeast of the project area, and suggested that the east-west crossing held special spiritual significance that was commemorated with rock art. Of particular interest in this regard are six trail shrines that Malcolm Rogers investigated in 1925 at the top of Indian Pass (Waters 1982c). These were large piles of incised basalt blocks or basalt block lined pits. Sacrifices of pottery, stone, bone, and shell were either thrown in the pits or on top of the rock piles. The largest shrines that contain only stones may date back to the San Dieguito period. Several shrines indicate reuse or rejuvenation, with the majority of the sherds dating to the Patayan I Phase (A.D. 700-1000). Some Patayan II (A.D. 1000-1650) sherds were also found. Rogers left a substantial file on Indian Pass at the San Diego Museum of Man, including maps of the trail system and notes on the lithics industry and inferences on the history of travel through the area.

Indian Pass remained an important route into the historic period. Johnston (1980) identified Indian Pass as the eastern end of the California portion of the "Maricopa Trail" based on archaeological reconstructions from Rogers (1966:43, 67) and Davis (1961:72), and on an 1821 report by Santiago Argüello and Don José María Estudillo of a visit by Maricopas to Mission San Gabriel (Bancroft 1886, II:442). Davis' small scale and simplified map hardly constitutes empirical archaeological evidence and Rogers failed to show an eastern continuation of the trail on the Arizona side of the Colorado River; these points hardly strengthen Johnston's arguments. Such a hypothetical route, however, might have crossed the Castle Dome Plain or gone northeast up Indian Wash and then connected to a trail that lead southeast to the Gila River via the Palomas Plain. Yet Indian Pass as a major prehistoric route cannot be denied and Johnston's geographical reconstruction from the 1821 account seems generally plausible in terms of the leagues indicated for a passage from Mission San Gabriel to the Colorado River, a trip of seven days.

According to the Maricopa chief who was interviewed in 1821: one day from San Sebastian to Jesus Maria, 26 leagues; one day to Pozo de la Alegría, 12 leagues; one day to the Méganos, 8 leagues; and one day to the river, "nearby" (Bancroft 1886, II:442; Johnston 1980:89). Johnston gives the last leg as 7 leagues but this is clearly not stated in the text. Pozo de Alegría ("Well of

Happiness") and Jesus Maria are assumed to be water sources in the Imperial Valley east of Obsidian Butte (Johnston 1980:89). "Méganos" apparently refers to the Sand Hills. Johnston has no direct evidence for Indian Pass as the prescribed route but a passage though the general area makes perfect sense for a Cocomaricopa chief. This route would bring him though friendly Halchidhoma territory, thus avoiding their Quechan enemies to the south and Mohave enemies to the north. This is a fact confirmed by other Mexican Period documents (Johnston 1980:91). Such information could also have been used to track Maricopa routes during one or more of the Romero Expeditions between 1823 and 1826 (Bean and Mason 1962). Johnston, however, may have misread Rogers' (1966:66) tracing of a trail across the Colorado River (Trail 2) as confirmation of an east-west route terminating at Picacho. The Indian Pass route does provide added detail to Lucas' description (in Cline 1984) of the duration and course for a crossing from San Sebastian to the Colorado River.

The Indian Pass trail system, best represented by CA-IMP-5359T, also connects to a major north-south trail system often referred to by Malcolm Rogers and others as the "Mohave War Trail" (CA-IMP-5360T). They intersect on a terrace west of the projects area and south of Indian Pass Road where there are trail shrines, rock alignments, pot drop, rock rings, and extensive evidence of human activity spanning the San Dieguito through Patayan II periods (CA-IMP-2727). This is the so called "Running Man Geoglyph" site. Although the "Running Man" may be a recent addition, the other features and artifacts attest to considerable activity at this major juncture. This trail played a pivotal role in the history of the Yuman people. It connected the Colorado River delta area and Yuma areas on the south with the Palo Verde Valley area on the north and beyond. The advantage of this route over the route directly along the river and east of the Purple Hills and Picacho Peak areas, was that it allowed easier and more undetected travel than could be afforded by the more direct route through the heavily populated Colorado River valley. One of its more recent uses was during the military campaigns by the Quechan-Mohave alliance to drive the Halchidhoma from the Colorado River, hence the misnomer "Mohave War Trail". The Halchidhoma were a Yuman-speaking group who were first reported in 1604 by Oñate to be living south of the Quechan below the confluence of the Gila and Colorado rivers. By 1700 they had moved north to occupy the area between the Quechan and Mohave from Picacho to Parker. Hostilities soon erupted between the Halchidhoma and their neighbors that lasted for over 125 years. Among the reasons given for the conflicts are competition for resources and trade routes, increased slave raiding exacerbated by the Spanish Sonoran slave trade, blood feuding or revenge raids, and the importance of warfare in the Yuman value system combined with a strong sense of nationality. The history of this long conflict is told in both Yuman oral tradition and contemporary written accounts (Kroeber and Fontana 86; Dobyns et al. 1963; Forde 1931:103; Kroeber 1925:799-802). It is very likely that among the uses of the "Mohave War Trail" was the Quechan access to Halchidhoma territory for the purpose of pursuing raids, and visa versa. The Quechan also fought with the Kohuanas and Halyikwamais to the south and by 1800 these groups joined the Halchidhoma, probably by use of this and other "inland" trails to avoid Quechan territory on the river. By 1827, however, most of the Halchidhoma and their allies were driven off the Colorado River to eventually join with the Maricopa on the Gila River above Gila Bend. Only a few remained but eventually left or assimilated into the Quechan over the next

25 years (Forbes 1965:253). The Quechan and Mohave eventually moved into the vacated territory.

This is only one episode in what must be a much longer history of use but it illustrates the primacy and strategic importance of the trail. Consultation with the Quechan will very likely reveal additional oral traditions that enhance its importance. It is also very likely the very same trail was used by Francisco Garcés, who as part of the second Anza Expedition (1775-1776) from Sonora to Los Angeles, left the main party at Yuma and in February of 1776 for a historic exploration of the Colorado River during which he wrote of his encounters with the Mohave, Chemhuevi, Hopi, and Zuni Indians(Coues 1900:213-216). A Mohave guide lead Garcés so it is natural that a traditional trail system would be used. At this time the Halchedhomas were enjoying peaceful relations with the Quechan and several approached Garcés at Yuma wanting to block his contact with their enemy, the Mohave. They tried to persuade Garcés to visit and stay with them first but refused to lead him on to the Mohave territory. Instead he decided to follow his original plan with a Mohave guide. He writes of leaving Pilot Knob and proceeding along the side (probably east side) of the Cargo Muchacho Mountains (Sierra de San Pablo), even mentioning that this looked like a good place to find gold.

The trails and associated trail-side cultural resources of Indian Pass have the potential to more specifically identify the periods of use, the mobility patterns, and the cultural traditions of the travelers who followed this route. The associated small rock rings and possible trail shrine localities in the survey area appear to be related to symbolic features that may add to our understanding of travel-related ceremonialism or symbolic behavior. Certainly trails are still recognized as having many levels of meaning for the modern Colorado River Yuman peoples and to be the subject of several oral traditions (von Werlhof 1987:13). Ceramics found in the survey area near trails can help to date their use in the late Prehistoric period. Preliminary examination of some of these sherds suggests a Patayan I, II, and ethnohistoric date. Many contained crushed sherd temper identified as Hedges Buff, a type found in late 19th and early 20th century contexts in the Cargo Muchaco Mountains mining sites and in Historic Yuma. This type may extend further back in time but this can only be determined by reconstructing the shape of broken vessels. Other sherds may be Salton Buff, suggesting a connection with Lake Cahuilla.

The two features interpreted as trail shrines include a rock ring covered with smaller stones and several piles of rocks located at the juncture of two trails. Similar examples have been recorded along trails on the Colorado River (Ezzo and Alschul 1993:94-95). These bear some similarity to the trail shrines recorded by Malcolm Rogers and may contain subsurface components or trail offerings. Such features provide insights into prehistoric ceremonial behavior related to travel.

The Indian Pass trails and associated features within the project area are considered eligible for the National Register of Historic Places based on criterion "A" as it relate to Yuman history, most recently known from the oral traditions associated with the Halchidhoma wars but also representing thousands of years of use. Additional Quechan consultation is certain to result in a greater understanding of Indian Pass cultural resources. The trails also appear to be directly connected with the trail system used by the Spanish explorer, Fr. Francisco Garcés in 1776 and

possibly with the Romero/Estudillo expeditions of 1823-1826. They are also considered significant under criterion "D": their potential to address questions of prehistoric travel, trade, and cultural interaction.

Geoglyphs

All of the geoglyph sites, except CA-IMP-7398, are evaluated as significant for both Native American religious values (criterion "A") and for scientific significance (criterion "D"). Where possible, in place preservation is recommended. The geoglyphs are examples of symbolic behavior, some of which appear to be oriented toward the trail system. Although many trails do not have associated geoglyphs, nearly all the intaglios along the Colorado River do have associated trails (Ezzo and Altshul 1993:21; Solari and Johnson 1982:425). One interpretation of the most impressive giant intaglios that are associated with a major north-south trail on the west side of the Colorado River is that they represent local ceremonial centers for the enactment of special *keruk* ceremonials. This included a ceremonial trek between the important religious sites of Pilot Knob and the Newberry Mountains (Altshul and Ezzo 1994:53).

The geoglyphs in the project area appear to have other associated ceremonial functions with analogs on the Colorado River. The geoglyphs, CA-IMP-7393 and CA-IMP-7397, are unusual in being very small circular rock rings with internal alignments. They are smaller than the "power circles" or "vision quest circles" described for other areas (Johnson 1985:37). These were 4-6 m diameter circles often associated with mounds of stone and also, broken milky quartz. Such places are thought to have been used for shamanic experiences, vision quests, or other spiritual activities that are known from ethnohistoric sources. The breaking of the white quartz would release power that along with fasting and sexual abstinence, would aid in the vision quest experience. The project area rock rings are less than one meter in diameter but are made from unexpectantly larger numbers of quartz fragments that indicate an association with power use or release. Such smaller circles and associated broken quartz has been documented in association with some of the larger geoglyph sites on the lower Colorado River, near landmarks with symbolic meaning such as Pilot Knob, or in association with trail systems (Altshul and Ezzo 1994: 55). They have also been reported from the Anza-Borrego Desert (Begole 1984a). The project area examples are not directly associated with trails but do occur along major washes that may have been routes of travel. In the case of the Chemgold project examples, the internal alignments are hypothesized to be directional indicators but this needs to be determined by examination of local terrain, trails, ethnohistoric accounts, and Native American consultation.

One geoglyph of unusual appearance is a phallic placement of an elongated rock and associated round rocks (CA-IMP-7398). It is associated with three chipping stations, a possible rock ring, a lithic scatter, and two cairns. It is also associated with several modern mining cairns, wood claim marker and is adjacent to a dirt road. When found in more certain prehistoric contexts, these are interpreted as phallic geoplyphs are known from the Anza-Borrego Desert and other locations around the world (Begole 1984b). Sometimes referred to as a *lingam* after the Hindu sacred stone, they may more appropriately be termed a *maδa'r* after the Quechan word for the male genitals (Forde 1931:150). Both male and female genital symbolism were used to acquire

power for reproduction and fertility. This example, however, differs in that it is erected on a boulder in a situation where long term preservation is unlikely. More probably it dates to recent historic times and may be contemporary with the road or historic mining claims. Pending Native American consultation, this geoglyph is evaluated as not National Register eligible.

The rock alignments at the so called "Running Man" geoglyph site, CA-IMP-2727, represent another category of geoglyph specifically associated with trails, in this case the apparent blocking of the Black Mesa or Indian Pass Trail, CA-IMP-5359T near where it intersects with the so called "Mohave War Trail", CA-IMP-5360T. A similar rock alignment occurs at the eastern end of the Coco-maricopa trail that leads all the way from the Colorado River at the Big Maria Mountains to San Gorgonio Pass and beyond to the Pacific coast (Schaefer 1985a). Von Werlhof (1987:79) provides other examples from the Mojave Desert in which much larger and more complex rock configurations are involved . Such rock alignments that bisect trails are interpreted as "spirit breaks" to prevent the passage of malign forces or spirits of the dead that could harm the traveler. These appear to be associated with trails of great antiquity that become reused in later periods (Rogers 1966:51; von Werlhof 1987:13). Also occurring at CA-IMP-2727 are several milky quartz chipping stations that may also be associated with vision and power quest localities, as discussed above. The "Running Man" geoglyphs is the only element of the site with questionable significance. The fact that it was not recorded in 1939 when Malcolm Rogers documented the site strongly indicates that it is a recent fabrication. Although the rest of the site is evaluated as significant, this element should be critically assessed in any further analysis of the site. Native American consultation on the problem of authenticating the "Running Man" geoglyph should also be made in future treatment of the site. In any event, the site as a whole is evaluated as significant under both criterion "A" and "D". It remains well outside the area of any direct impacts although efforts to avoid indirect impacts are recommended below. Further consideration is given to CA-IMP-2727 below as a separate and unique site.

Pot Drops

All of the potdrops are evaluated as National Register eligible. Two of the four pot drops or ceramic scatters are associated with trails. Pot drops can occur from accidental breakage during transport. Pots can also be ceremonially broken or "sacrificed" at a trail shrine or at designated places along a trail. Often this type of pot drop is associated with an approach to a water source or some important geographical feature. The Chemgold examples are not so clustered that a ceremonial function can be inferred. However, these pot drops are also important for dating trail use in the Late Prehistoric and ethnohistoric periods and for indicating the place of manufacture of the pot for reconstructing lines of communication and transport. As such they are evaluated as significant under criterion "D".

Possible Milling Element at CA-IMP-7382

Site CA-IMP-7382 is evaluated as not significant because the associated possible milling feature is of too questionable function. Site CA-IMP-7382 contains five chipping stations, a retouched flake, and a possible milling slick. The milling feature, although ephemeral, would be a rare

occurrence in this area. Only one portable metate was ever recorded during the thousands of acres covered for the Mesquite Mine project and no others were found in the Imperial Project area. One of the reasons is the paucity of favored vegetal foods in this region, palo verde and catclaw being considered famine foods and native grasses being sparsely distributed. It is also unlikely that women would have transported their heavy wooden mortars and long stone pestles to such a location, and if they did, the mortars would not preserve and the pestles would be carried away. The site is located on a small desert pavement terrace remnant in an area of large ephemeral washes. Such an area may have sustained some vegetal food gathering activities but the paucity of finished tools and low artifact density and diversity does not support the interpretation of a temporary camp at CA-IMP-7382. Nevertheless, it is recommended that the large boulder with the possible slick be removed to another location for future study.

World War II Historic Sites

BLM has previously determined small bivouac sites in the region to be not National Register eligible (Schaefer and Pallette 1993: V-7). They were considered to lack integrity of setting, feeling, and associations for consideration of significance under criteria "A" and "B" that are more readily appreciated at the larger encampments and divisional headquarters. The present survey and evaluation level documentation provided above and below is therefore considered sufficient to expend the research value of these sites under criterion "D" and they are therefore evaluated as not National Register eligible.

The southern California and western Arizona desert regions became the focus of historically important training exercises during World War II. The Desert Training Center (DTC) was opened on April 30, 1942. The normally serene desert gave way to the rumble of tanks and staccato of machine guns for almost two years until 1944. The largest military training installation ever to have existed, the facility had none other than General George S. Patton Jr. as its first commanding officer (McKenna 1991:15, 1992; Meller 1946). General Patton had proclaimed the DTC "probably the largest and best training ground in the United States" (Meller 1946:35). It served the vital purpose of conditioning troops to desert warfare conditions and tactics in preparation for the North African Campaign. The center was also used to field test numerous pieces of equipment and supplies. The facility extended from the Colorado River on the east to a point slightly west of Desert Center, California, on the west and from Searchlight, Nevada, on the north to Yuma, Arizona on the south. This Basin and Range Province was ideal in that it contained a variety of terrain types and no large population centers (Howard 1985:273-274). Patton left with his troops for North Africa in 1942, but the DTC or C-AMA continued throughout the war processing several million troops.

Following the success in North Africa an emphasis on desert warfare was no longer necessary. The name of the Desert Training Center was changed to the California-Arizona Maneuver Area (C-AMA or CAMA) on October 20, 1943, and its purpose expanded to a simulated theater of operations emphasizing other large-scale logistics and not exclusively desert warfare tactics. This included solving complex communications and supply problems, and Army Air Force support of ground troops (Howard 1985). The facility then provided maximum training of combat troops,

service units, and staff under conditions similar to a combat theater of operations. Under Maj. Gen. Charles H. White, the training area was enlarged to extend from Gila Bend, Arizona, on the east to a point 350 miles from Pomona, California, on the west and from Yuma, Arizona, on the south, to Boulder City, Nevada, on the north (Howard 1985:281-282). Command would change three more times before C-AMA closed. The DTC/C-AMA contained 11 major camps - with seven in California and four in Arizona - and trained over a million troops in its two years of operation.

During the DTC period, exercises emphasized operating with restricted water supply, sustaining operations remote from railheads, resupplying under cover of darkness, and combined training with the Army Air Force (Howard 1985:274). A four phase training program was developed that would not exceed six weeks in duration. The first phase training emphasized the individual, crew, squad, section, and platoon. The second concentrated on the company and battery. The third phase consisted of battalion training, and the fourth emphasized the combat team whereby armored units, air, and ground forces were all coordinated. The training program ended with an exercise lasting several days and covering about 300 miles. Advanced supply bases were established along projected routes, tactical maneuvers were conducted in darkness, and tactical bivouacs were established in the presence of hostile air and mechanized threats (Howard 1985:278; Meller 1946:13).

Training during the C-AMA period consisted of a 13 week program. Firing ranges of all types were constructed and troops trained with pistols, machine guns, rifles, and artillery. They also took courses in infantry tactics using live ammunition. Emphasis was placed on development of platoon efficiency. Platoons of 40 to 45 men were sent out on six day field problems involving directional skills and coordination with supply units. The three final weeks consisted of maneuvers. The first exercise involved a defensive force establishing a position for the purpose of protecting a vital area or installation. The second exercise consisted of field maneuvers that simulated a campaign of approximately 11 days and 10 nights designed to test the endurance of units and their ability to fight, and resupply over great distances while providing daily maintenance of equipment and recovery and evacuation of disabled vehicles (Meller 1946:62). Following action in Libya, American troops trained at DTC/C-AMA went on to fight at the Normandy invasion, throughout western Europe, Italy, Guam, and the Philippines (Meller 1946: Appendix J).

Spartan camp conditions were deliberately maintained to provide soldiers with a realistic, battle-ready experience. Through the history of C-AMA, orders were periodically given to prevent any center from lapsing into more comfortable conditions. No units were allowed to stay too long at any center. The most mobile were supplied with B-rations and C-rations and no screened eating areas would be provided. A trash pit of discarded field rations was actually found at one of the sites in the project area. The Ground Surgeon was well aware that during the warmer seasons, flies would cause near epidemics of dysentery. Screened eating areas were therefore advised for service units that had to remain in certain areas, such as base camps, for longer periods. However, orders were subsequently given that no new screened areas were to be built and old ones would not be maintained. Iced fresh food was also prohibited. Lowered morale from the

monotony of B-rations, disease outbreaks, and even some reported deaths and public protest eventually lead to some relaxation of these severe conditions. Shortly before C-AMA was closed all units were allowed to enjoy A-rations (Meller 1946:50-55).

The World War II sites, CA-IMP-4970H, -5067 (historic component), -5530 (historic component), and -7395/H are small bivuoac-type sites associated with the implementation of tactical exercises and the daily lives of the G.I. trainees. Such sites reflect training activities in the lower ranks of the U.S. Army: the individual, squad, and/or platoon. The large divisional camp sites reflect the activities that surrounded field commanders at their operational headquarters, their support and supply staff, and centralized operations. Camp Pilot Knob was the nearest major command headquarter to the Indian Pass area. The camp operated from early 1943 until April, 1944, but the peak period of training at the camp was between June and November of 1943 (Chamberlin 1990:19). These dates are supported by the field ration cans found in Feature 10 at CA-IMP-5530. Camp Pilot Knob was home to the 85th Infantry Division. They were known as "the Custermen" or "the Custer Division" because they were activated in 1917 at the Battle Creek, Michigan camp named in honor of the Civil War era Michigan cavalry brigade commanded by General George Armstrong Custer (Schultz 1949).

Training at the Camp Pilot Knob focused on hardening troops to the desert environment and live fire practice; experiencing both outgoing and incoming ordnance. Also operating out of the camp were the 36th and 44th Reconnaissance Squadrons of the 11th Cavalry Group, part of the 13th Corps of the U.S. 9th Army. These squadrons practiced encountering the enemy and reporting back troop strength and positions (Patton 1942).

The importance of small unit training is underscored in Paul Schultz's history of the 85th Infantry Division while operating out of Camp Pilot Knob:

> ...special emphasis was placed on the thorough development of the efficiency of the small unit. This was the platoon, which was composed of a platoon leader (second lieutenant) and forth to forty-five men. Platoons, as a combat in Africa and the Pacific had demonstrated, were often instrumental in turning the tide of battle. Platoon leadership courses were devised and the Custermen went out in platoons for six-day problems. The responsibility and leadership of individual squad leaders was stressed; for, on the desert, it was easy to get lost. Men had to know how to determine direction, how to safeguard water supplied, how to coordinate with supply units so that they could find their supplies of food and ammunition at designated points. They had to have some plan of action if they missed the supplies and were forced to go for a day without food or new water supplies (Schultz c.1949:35, quoted in Chamberlin 1990:25).

The arrangement of features at CA-IMP-5530 differs from previously recorded bivouac sites in the nearby area (Schaefer 1993:IV-28,29). The bivouacs usually contain orderly rows of sleeping pads with an officers tent, mess tent, or other facilities occupying a central location. Depending on the length of use and level of discipline, there may be rock lined paths, tent placement, and fire hearts

more randomly placed and tent pads are not obvious. This may have been intentional to avoid detection or effective air attack (Patton 1942). Sleeping areas were probably in the cleared areas at the north end of the site (shots 1-11). The areas of the cairns and most of the rock rectangles are covered with boulders and cobbles and would have been barely suitable for sleeping, but may have been locations for machine gun emplacements. Absence of shells or machine gun clips suggests that live fire exercises were not undertaken here. What special functions or exercises took place at this site that left the line of cairns and configuration of rectangular rock features remains a mystery. These sites may therefore best be interpreted as a short-term use areas at the platoon level in which mobility and combat readiness were priorities.

CA-IMP-2727,-5359T, and -5360T: "The Running Man Geoglyph Site", "Mohave War Trail", and "Black Mesa Trail".

These three sites are evaluated together because they are all associated with each other, converging at CA-IMP-2727. The geoglyph site lies well outside the project area, and only small portions of the trail are bisected by the existing Indian Pass Road and are likely to experience little additional impacts, even from road improvements. Indirect impacts to the more sensitive geoglyph site are a consideration and therefore full treatment to these resources is given below.

All three sites are evaluated as eligible under criterion "D" because they have in the past and can continue to provide important information on prehistoric and ethnohistoric Native American culture history, trail usage, transport, and symbolic behavior. The study of ceramics along the trail can be used to reconstruct periods and directions of population movement both up and down the Colorado River as well as potentially between the Colorado River and Lake Cahuilla.

All three sites are also evaluated as National Register eligible under criteria "A". Sites CA-IMP-5359T and IMP-5360T are related to Quechan history, most recently the Halchidhoma wars and more generally to documented contacts and communication between the Quechan, Halchidhoma, and Mohave (described above). It was likely on trail CA-IMP-5359T that Fr. Francisco Garcés conducted his tour of the Colorado River in 1776, providing some of the first detailed written descriptions of the peoples of this region.

Consideration should also be given for the evaluation of CA-IMP-2727, -5359T, and -5360T as eligible under criterion "B: that are associated with the lives of persons significant in our past" (36 CFR 60.4), as it relates to the life work of Malcolm Rogers, the father of Colorado Desert archaeology.

As previously discussed, Rogers recorded these sites in 1939 and 1941 as part of his continuing effort to document the regional archaeological record and reconstruct the culture history of the Colorado Desert. His notes were instrumental for recognizing that "The Running Man Geoglyph" is probably a recent historic fabrication. Trails and their associated artifacts were a particular focus of Rogers work because with the absence of buried and stratified sites, he had to chronologically arrange trail segments as a way to relatively date artifacts on desert pavement

As previously discussed, Rogers recorded these sites in 1939 and 1941 as part of his continuing effort to document the regional archaeological record and reconstruct the culture history of the Colorado Desert. His notes were instrumental for recognizing that "The Running Man Geoglyph" is probably a recent historic fabrication. Trails and their associated artifacts were a particular focus of Rogers work because with the absence of buried and stratified sites, he had to chronologically arrange trail segments as a way to relatively date artifacts on desert pavement surfaces. This was based on the fact that trails would fall out of use over time due to natural erosion or other factors and be replaced by new routes or detours. Among his observations to relatively date trails were intentionally placed rock alignments that indicated symbolic closings of older trails. He also observed the amount of erosion and depth to which the trail was incised in the desert pavement. With this information, he then proceeded to compare artifacts on different trails to derive in essence a "horizontal trail stratigraphy" (Waters 1982a:276). This approach was central to his development of a ceramic and Late Prehistoric culture sequence for the Colorado Desert (Rogers 1945).

Julian Hayden best summarized Malcolm Rogers's contribution to desert archaeology when he introduced Rogers 1958 article on San Dieguito implements from southern Arizona. Hayden wrote:

> To the older men in southwestern archaeology, he needs no introduction; this is directed primarily to the younger men, the recent graduates and present students, to whom Mr. Rogers is known as a semi-legendary master of desert archaeology and as the author of a knotty and difficult report.
>
> Educated before the onset of the age of specialization, when it was still possible for a man to believe that he might be able to learn everything about everything, Mr. Rogers can be compared only to the English natural historians of the Victorian Era in his command of a multiplicity of knowledge, a command required in the solution of the problem of Early Man in the deserts, a task in which he has been engaged for nearly 40 years. Working backward from the present, he mastered Yuman ethnology and Yuman ceramics; combining this knowledge with climatology, physical geology, biology and anthropology enabled him to go to the beginnings of ceramic history in the area, thence to Early Man, both in the desert and on the Pacific Coast.
>
> Mr. Rogers's pioneering entry into the area preceded the swarm of relic hunters and amateur archaeologist, land developments and the destructive floods of recent years, which have so utterly destroyed the pristine archaeological context of the deserts in which he worked. He has walked literally hundreds of miles of ancient and prehistoric trails, surveyed the beach terraces of the old Blake Sea and the Mohave sinks with such thoroughness. that later workers reported "no sherds to be found"-Mr. Rogers has collected them all. His knowledge of the relationships between climate and changing physiography and their effect upon Early Man has become almost intuitive.

> A constant striving for simplicity and practicality and an emphasis upon patterns rather than upon the unique or the unusual element of an ignored pattern-for example, the variations in point types which have resulted in the naming of so many "complexes"-is fundamental in Mr. Rogers's approach to the problem of Early Man (Hayden, Introduction in Rogers: 1958:1-2).

Born Sept 7, 1890 in Fulton New York, Rogers studied mining geology at Syracuse University and practiced in the Pacific Northwest between 1917 and 1918 (Ezell 1961; Hanna 1982). After a year of U.S. Government work he joined the Marine Corps for another year and then took up citrus farming in Escondido, California. It was in this period that he first became acquainted with the five-year old San Diego Museum of Man as a part-time volunteer field archaeologist. His first published article (Rogers 1928) was on the results of a brief reconnaissance of the Lower Gila River in which he is designated an Associate in Archaeology. By 1930 he was the full time Curator. He served as both curator and administrator until the end of 1945 when the Museum of Man became a temporary hospital for World War II casualties. Unable to function at Museum, Rogers resigned and moved to Hipass, California with his second wife, Francis, with whom he had four children. Poor health forced him to relocate to Scottsdale, Arizona, to live with Francis's mother. Regaining his health, by 1957 Rogers found himself in serious financial trouble and separated from his family. He sought work outside of archaeology with friends supplementing his income. He came to live with part-time archaeologist, Julian Hayden, in Tucson where he resumed his field trips and publications. Eventually with the help and support of close friends, he returned to the Museum of Man as Research Associate in 1958. He spent the next two years reorganizing the collections and amending his field notes for publication. He was tragically killed in a traffic accident on September 11, 1960. At the time he was finishing his magnum synthesis of the San Dieguito culture, *Ancient Hunters of the Far West* that was completed posthumously (Rogers 1966).

Rogers published thirteen books, monographs, and articles. Although not a prolific writer, he made an enormous contribution to southwestern archaeology that remains the foundation for all subsequent work in the region to this day. His most important contributions include excavation of the Harris Site - type site for the San Dieguito Culture, recording of hundreds of sites, establishment of a culture chronology for southern California and southwestern Arizona, definition of the San Dieguito and Archaic lithic assemblages, and development of the Late Prehistoric cultural chronology and Patayan ceramic series.

There can be little doubt that his research at the trails and trail shrines of the Indian Pass area contributed to his development of the Yuman culture sequence. He made extensive ceramic and lithic collections along the trails leading up to the pass and excavated one of the shrines at the pass. The trail shrines at Indian Pass proper (San Diego Museum of Man Site C-1) and at "The Running Man Geoglyph Site" (C-70) are specifically illustrated in Rogers' (1966) last synthesis.

Application of criterion "B" must be used with caution, however, since Rogers recorded hundreds of sites throughout the area and not all can be shown to have directly influenced his work, although they certainly had a cumulative bearing on his ideas. Rogers' field note entries

many field seasons and left many pages of field notes and even the physical remains of his field camp (Schaefer 1993; Schaefer, et al. 1993). That site is actually being nominated as a contributing property to the White Tanks National Register District with Rogers' scientific contributions and presence accounting for significance under criterion "B". The three sites under question here have no such direct physical evidence of Rogers' presence nor stand out as primary in the history of his research.

Site CA-IMP-2727 represents a ceremonial activity area related to the juncture of two major transportation corridors. As such it also bears on the historical patterns mentioned above. In addition it contains rock alignments, trail shrines, and other features and artifacts with special Native American religious values. The "Running Man" geoglyph, however, is most likely a recent historic fabrication that may be of Anglo origin. Additional consultation with the Quechan should be undertaken to determine if it may be a recent Native American element, but if not, should not be considered a contributing element to the significance of the site.

D. Impacts and Management Recommendation Impacts

The proposed Chemgold Imperial Project is an open-pit, heap-leach, precious metal mine which would utilize conventional heap-leach mining methods. The project would include: mining gold and silver ore and waste rock at a maximum average operating rate of 120,000-tons per day for up to twenty (20) years; constructing facilities to administer the operation; maintenance of all mining and related equipment; processing the ore and stockpiling the waste rock; developing and producing ground water for use in processing operations; performing continuing mine exploration activities; implementing wildlife impact reduction measures; and implementing site reclamation measures.

The proposed project would consist of the following components:

- Three (3) open pits, identified as the West Pit, East Pit and Singer Pit and one (1) Mineralized Potential Area, co-joining the three (3) separate pits;
- Four (4) waste rock stockpiles;
- Up to four (4) soil stockpile sites.
- One (1) administration office and maintenance facility area;
- One (1) heap leach facility in which up to 150-million tons of ore would be leached under the Proposed Action;
- One (1) precious metal recovery plant and other related facilities;
- A system of roads internal to the project site which would connect the various facility components;

- One (1) ground water well field, consisting of up to four (4) production wells, designed to produce ground water at a peak rate of approximately 1,000-gallons per minute (gpm) and yield approximately 1,200-acre feet per year (afy), and an associated water pipeline; and

- A portion of Indian Pass Road, approximately 6,000 feet, would be relocated approximately 1,000-feet to the west of its current location to allow continued public access to areas north of the Project. Project traffic on Ogilby Road and Indian Pass Road is estimated at approximately 47 lightweight vehicle round trips, and 4 heavy truck round trips, per day. Approximately 100 workers may be required to construct the project facilities, although only a portion of these workers would be at the project site at any given time. Approximately 150 workers would be employed to operate the project.

The project area will be surrounded by a perimeter fence within which the facilities are closely arranged (see Figure 2, project boundaries). Direct impacts to virtually all cultural resources is expected within the project area, with the little potential for avoidance except in a few small areas next to Indian Pass Road and around the perimeter fence. The only way for sites to remain in place is under the ore leach pads or waste rock stockpiles. Careful study and analysis of these sites would resolve impacts to scientific values but consultation should be pursued to determine if burying some sites may possibly mitigate impacts to Native American values.

No appreciable indirect or cumulative impacts to sites outside the perimeter fence are expected from increased usage of Indian Pass Road. It is already a well graded and maintained road and no increased access will result from the mine project.

Chipping Stations

Direct impacts are expected at all but two of the chipping stations and lithic scatters because they occur within the fenced perimeter of the project area. Two sites, CA-IMP-7389 (three chipping stations) and CA-IMP-7402 (one chipping station), occur in the buffer zone and attempts will be made to avoid all of these. For the remainder, it is recommended that a 10% random sample of the chipping stations be collected and subjected to laboratory analysis. Additionally, it is recommended that 0.1% of the surface area of recorded sites be analyzed in the field using the SHPO's CARIDAP light density lithic scatter surface observation grids. It is further recommended that a sample of several types of high quality ccs be collected and curated to assist future research in lithic sourcing. More detailed mapping of the trail system through this area, already recommended as significance testing for the trails, will assist in the interpretation of the chipping stations.

The following research approaches might reasonably be taken:

1) Multivariate analyses of cores and debitage provide insights into lithic technology (e.g. core based technology v. flake based technology). As noted above, quantitative attribute studies of desert lithics are many, however, some similar work should be undertaken on a sample from the

current study area to avoid making any *a priori* assumptions about the assemblage. Data Requirements: Collection and attribute analysis of a sample of chipping stations within the project area. The accompanying lithic scatters should be recorded using a sampling strategy which conforms to the requirements of the SHPO's CARIDAP light-density-lithic-scatter protocol.

2) Mapping the distribution of chipping stations, especially *vis-a-vis* trails, can tell us about hunter-gatherer mobility and the value (or scarcity) of raw materials. If raw lithics were a high priority, we should see a homogenous distribution of chipping stations across the desert pavement terraces. If it was a lower priority, lithic prospecting will cluster near the trails. Data Requirements: More precise mapping of trails. Cautious extrapolation of no longer visible trails based on identified segments might be useful.

3) Quantitative study of lithic material preference, as measured by core presence/absence, could reveal something about what types of tools were required, and therefore what types of activities were undertaken. Hard material, such as rhyolite or basalt, is more difficult to work, but provides a sturdier finished product. Cryptocrystalline silicates (ccs), especially when heat-treated, are easier to flake, but produce more brittle tools. A higher relative percentage of hard stone cores removed from chipping stations would suggest a greater requirement for rough-duty choppers. Preference for the more brittle silicates, however, would indicate the finishing of smaller, finer tools, such as projectile points and small cutting tools. This could further reflect on the subsistence strategies of mobile prehistoric peoples. If no significant difference was found in the relative percentages of core collection of either type of stone, it might be concluded that material availability played a greater role, or that all tool types were required. The underlying assumption is that the absence of a core from a chipping stations means that the individual testing the stone found it to be adequate and collected the largest piece of it, a core, to cache or carry back to a main residence. Data Requirements: The statistical comparison of chipping stations with and without cores and corresponding material types. Enough data has been collected in the survey phase to conduct this analysis.

4) Great strides have been made in the sourcing of obsidian (Shackley 1994, Hughes 1986, Hester 1978, etc.). Attempts at sourcing turquoise have also been undertaken, with promising results (Weigand and Harbottle 1992). Sampling and analysis of the composition of lithics (particularly ccs) from the current study area could assist in locating the destinations and affiliations of the prehistoric people who traveled through here, and could add to a growing body of lithic source data. Data Requirements: This would require curation of samples of several different colors of high quality ccs as a data base for future researchers who may want to undertake a comparative analysis of lithic sources.

All but Issue No. 4 are complicated by a lack of chronological control in surface finds. Recent attempts to date surface lithics using cation ratio dating (Dorn 1982) have met with considerable criticism (Harry 1995, Dragovich, 1988, Bednarik 1988). Until this conflict can be resolved, archaeologists will have to live with the ambiguity of dating surface finds.

Rock Rings and Cleared Circles

Direct impacts are expected at all of the rock rings and cleared circles. All of the cleared circles and most of the rock rings are evaluated as not National Register eligible because previous studies have shown they lack subsurface deposits and that information obtained beyond the survey phase is not likely to further our knowledge of the regional prehistory (Schaefer 1987; Shackley 1988). The one exception is CA-IMP-7393 where two rock rings are associated with lithics that may provide additional information about site function. It is recommended that scale drawings be made of these prehistoric rock rings at this site in relation to the lithic scatter and that data recovery be undertaken.

Trails

Direct impacts are expected at most of the trails within the project area, however some opportunities for site preservation may be present. Each trail will be discussed in numerical order. The trail, pot drop, and chipping stations at CA-IMP-5067 lie between Indian Pass Road and the proposed waste rock stockpile. This site will be directly impacted. The trails at CA-IMP-5359T and -5360T, discussed below with reference to the "Running Man Geoglyph" site, are located southeast of the main project area and and will not be impacted as long as the present Indian Pass Road area of existing grading is not expanded. As these trails cross Indian Pass Road at perpendicular angles, only minimal impacts would result from improvements to the existing dirt road.

The two trail segments and trail markers or trail shrines at CA-IMP-5529 are in the area of the proposed ore leach pad. The site will experience direct impacts. The trail segments on the ridge that makes up CA-IMP-5530 will be directly impacted by the west pit and the waste rock stockpiles. The convergence of two trails at CA-IMP-7388 is located in the buffer zone at the far northeast corner of the survey area and will therefore not experience direct impacts. The southern branch of the trail can also be avoided by realignment of the waste rock stockpile. One of the longest trail segments in the project area is CA-IMP-7409. The northern tip will be directly impacted by the lime bin area and the remainder of the site will be directly impacted by the leach pad.

A small trail segment, CA-IMP-7412, is located on a alluvial terrace southeast of Indian Pass Road and is separated from the road by a small wash. What makes the trail segment unusual is the associated trail shrine, composed of a rock ring with central rock cairn in which numerous quartz cobbles have been placed (Figure 5). The trail and feature are sufficiently distant from Indian Pass road to avoid direct impacts. Any road improvements or modifications should be designed to avoid impacts to this site. No impacts are therefore predicted. Native American consultation should also be undertaken to determine if additional avoidance measures may be appropriate.

A 38 m long trail segment at CA-IMP-7415 (feature 24) is associated with two chipping stations and a small lithic scatter. It is located on an alluvial terrace containing numerous chipping stations

and a lithic scatter from stone sampling and reduction for stone tool production. The site will experience direct impacts from the proposed heap leach facility.

Full data recovery is recommended at all of the trails that will experience direct impacts. This should entail careful mapping of the trail segments and determining their destination and full extent for a reasonable distance outside of the project boundaries. In this regard, the linkages of the Indian Pass trail network to long-distance routes has not been fully examined. Among the variables to be recorded are degree of imbeddedness in the pavements, amount of stone displacement, and variability of trail width and depth. The margins of each trail should be carefully examined for associated artifacts that indicate their date and origin of users. All artifacts should be carefully mapped and recovered for analysis. Ceramics are most helpful in this regard. The trail shrines should be carefully plotted with maps drawn that indicate all of the stone types and artifacts in association. These should not be disturbed and with Native American consultation, measures should be taken to ensure their preservation. Additional consultation should also be carried out with Native American consultants to document tribal history and oral traditions associated with trails and other cultural resources in Indian Pass and to develop cultural contexts. The trail study should also include examination of the extensive ceramic and artifact collections from Indian Pass collected by Malcolm Rogers at the San Diego Museum of Man. These data can be used to better understand the chronology and travel patterns.

Geoglyphs

Four sites contain geoglyphs or symbolic rock alignments. The largest is CA-IMP-2727 and will be discussed separately below because it is the most complex and lies just outside the project area. The other three include two small rock circles and one phallic rock alignment that appears to be of historic date. The two circles, CA-IMP-7393 and CA-IMP-7397 are located on alluvial terraces and are not spatially associated with trails. CA-IMP-7393 will experience direct impacts as far as future research potential is concerned because it is located in the area of the proposed ore leach pad. CA-IMP-7397 will be avoided and will not receive direct impacts. Impacts to scientific values can be mitigated by data recovery. To accomplish this, each will be carefully drawn and photographed, indicating the type of stone used and determining if non-random selections were made of certain stone types, particularly quartz. Native American consultation will also be made to determine their symbolic significance and develop cultural contexts. Mitigation of Native American religious and historical values will require careful consultation. It is presumed that in place preservation would be the preferred alternative. Indirect impacts to CA-IMP-7397 can be mitigated through project planning and avoidance by appropriate signs and fencing, if necessary. At site CA-IMP-7393, one possible approach would require preservation under the four inch sterile bedding layer followed by the 40-mil and a 30-mil PVC liner, after which the heap leach facility will reach a maximum height of 300 feet. Whatever approaches are taken will be developed through Native American consultation.

The other "Geoglyph" is a construction of stones that resembles a phallus (CA-IMP-7398). It is also associated with two cairns, a chipping stations, a lithic scatter, and a poorly preserved rock ring. Also found in association are a dirt road, mine claims, and other recent historic features that

may indicate a modern date for the "geoglyph". This site is located on an alluvial terrace in the east central portion of the project area where it will be directly impacted by the East Pit. Any mitigation measures should be undertaken through Native American consultation to first determine if this feature is genuine and if so, then to make appropriate arrangements for documentation and interpretation. Careful recording, photography, and interpretation through comparison with other examples and elicitation of Quechan oral traditions associated with rock constructions would mitigate impacts to scientific values. Native American consultation will be necessary to mitigate impacts to religious or historical values.

Pot Drops

All of the pot drops are likely to be directly impacted. Although isolated pot drops are not likely to be National Register eligible, when found in association with trails have enhanced value for reconstructing periods of trail use and mobility patterns. Half of the four pot drops appear to be trail associated while the others are indefinitely associated. It is recommended that all of the pot drops, including the one documented during the previous survey, be mapped and collected to establish the ceramic types, date, and attempt reconstruction of shapes. These data will be very useful in establishing the overall historic contexts of the area for the Late Prehistoric period.

World War II Historic Sites

Despite the fact that the World War II period sites are not considered National Register eligible, some opportunity for site preservation is evident from the impact projections.

CA-IMP-5067

The historic rock rectangle lies between a large wash and prehistoric trail segment on the east and Indian Pass Road on the west. This area lies within the West Pit area. Direct impacts are therefore anticipated.

CA-IMP-5530

The northern half of this site will be directly impacted by the shop and office facility, and secondarily by the waste rock stockpile located directly to the north. To the south, most of the rock cairns and a sample of rock rectangles, semi-circles, and rock rings, both on the lower terraces and ridge top, will remain in the buffer zone or just south of the project boundary fence.

CA-IMP-4970/H and 7395/H

The historic rock alignments at CA-IMP-4970, previously recorded in the area surveyed by Schaefer and Palette (1991), and those related alignments at CA-IMP-7395/H are located on a ridge top that will be directly impacted by the edge of the west pit and waste rock stockpile to the north. Although they are evaluated as not significant, adequate mapping and recording have been undertaken and no additional treatment is recommended.

CA-IMP-4970/H and 7395/H

The historic rock alignments at CA-IMP-4970, previously recorded in the area surveyed by Schaefer and Palette (1991), and those related alignments at CA-IMP-7395/H are located on a ridge top that will be directly impacted by the edge of the west pit and waste rock stockpile to the north. Although they are evaluated as not significant, adequate mapping and recording have been undertaken and no additional treatment is recommended.

Sites CA-IMP-2727,-5359T, and -5360T: "The Running Man Geoglyph Site", "Mohave War Trail", and "Black Mesa Trail".

Site CA-IMP-2727 is sufficiently distant to avoid any direct impacts from any possible modification of Indian Pass Road and installation of a parallel pipeline. This extremely sensitive ceremonial site is separated from the road by a broad wash that may also discourage off-road vehicle activity. It is recommended that no fence or signs be erected that may draw attention to the site. No berm or other barrier should be placed along the road in this area as it may actually encourage off-road vehicular activity on the opposite side. It is recommended that the site be inspected several times during the first year of mine operation to make sure that no additional off-road vehicular activity accompanies the mine development. Additional protective measures can then be developed if an increased potential for indirect impacts is indicated. Any final mitigation measures should also be undertaken in consultation with the Quechan Nation.

Some impacts are expected to the segments of the trail that immediately abut and have been previously bisected by Indian Pass Road. Direct impacts are possible for the small portion of the Indian Pass or Black Mesa Trail, CA-IMP-5359T that parallels Indian Pass Road before crossing to the north side. Careful project design and possibly placement of a small berm in this area can prevent these direct impacts.

VII. REFERENCES CITED

Altschul, Jeffrey H. and Joseph A. Ezzo
1994 The Expression of Ceremonial Space along the Lower Colorado River. In Recent Research Along the Lower Colorado River, edited by Joseph A. Ezzo, pp. 55-67. *Statistical Research Technical Series No. 51.* Tucson, Arizona.

Anyon, Roger
1995 Letter to the Editor. *Society for American Archaeology Bulletin* 13(5):3-4.

Anyon, Roger, T.J. Ferguson, Loretta Jackson, and Lillie Lane
1996 Native American Oral Traditions and Archaeology. *Society for American Archaeology Bulletin* 14(2):14-16.

Baksh, Michael
1994 Ethnographic and Ethnohistoric Insights Into the Quen Sabe Intaglios, In *Recent Research Along the Lower Colorado River,* edited by Joseph A. Ezzo, pp. 15-48. Statistical Research, Tucson, Arizona.

Bamforth, Douglas B.
1992 Quarries in Context: A Regional Perspective on Lithic Procurement. In *Stone Tool Procurement, Production, and Distribution in California Prehistory,* edited by Jeanne E. Arnold, pp. 131-150. Institute of Archaeology, University of California, Los Angeles.

Bancroft, Herbert H.
1886 *History of California.* The History Company, San Francisco.

Bean, Lowell J. and William M. Mason
1962 *The Diaries and Accounts of the Romero Expeditions in Arizona and California, 1823-1826.* Palm Springs Desert Museum, Palm Springs, California.

Bednarik, R.G.
1988 Comment on M. F. Nobbs and R.I.Dorn, Age Determinations for Rock Varnish Formation within Petroglyphs: Cation-ratio Dating of 24 Motifs from the Olary Region, South Australia. *Rock Art Research* 5:124-126,139.

Bee, Robert L.
1981 *Crosscurrents Along the Colorado.* University of Arizona, Tucson.
1983 Quechan. In *Southwest*, edited by Alfonso Ortiz, pp. 86-98. Handbook of North American Indians, Vol. 10, William G. Sturtevant, general editor. Smithsonian Institution, Washington D.C.
1989 *The Yuma.* Chelsea House, New York.

Begole, Robert S.

1973 An Archaeological Survey in the Anza-Borrego Desert State Park: 1972. Preliminary Report. *Pacific Coast Archaeological Society Quarterly*. 9(2):27-55.

1976 A Continuing Archaeological Survey in the Anza-Borrego Desert State Park: 1975-1976 Report. *Pacific Coast Archaeological Society Quarterly* 12(2): 1-24.

1984a Equinox, Solstice, and World Renewal. *Pacific Coast Archaeological Society Quarterly* 20(4): 1-12.

1984b Fertility Symbols in the Anza-Borrego Desert. *Pacific Coast Archaeological Society Quarterly* 20(4): 13-28.

Binford, L.R.

1979 Organization and Formation Processes: Looking at Curated Technologies. *Journal of Anthropological Research* 35:255-273.

Bureau of Land Management

1986 *Desert Training Center, California-Arizona Maneuver Area, Interpretive Plan.* U.S. Department of the Interior, Bureauof Land Management, California Desert District.

Cachora, Lorey

1994 The Spirit Life of Yuman-Speaking Indians: Lower Colorado River Between California and Arizona. In *Recent Research Along the Lower Colorado River,* edited by Joseph A. Ezzo, pp. 13-14. Statistical Research, Tucson, Arizona.

Carrico, Richard, Dennis Quillen and Dennis Gallegos

1980 *Cultural Resource Inventory and National Register Assessment of the Southern California Edison Palo Verde to Devers Transmission Line Corridor (California Portion).* Report prepared by WESTEC Services, Inc. for Southern California Edison.

Castetter, Edward F. and William H. Bell

1951 *Yuman Indian Agriculture*. University of New Mexico Press, Albuquerque.

Chamberlin, Eugene K.

1990 *Camp Pilot Knob.* Squibob Chapter, E Clampus Vitus, Campout #56, Camp Pilot Knob, Imperial County California. Manuscript on file, ASM Afffiliates, San Diego.

Cline, Laura

1984 *Just Before Sunset.* J and L Enterprises, Jacumba, California.

Coues, Elliot

1900 *On the Trail of the Spanish Pioneer. The Diary and Itinerary of Francisco Garcés.* Francis P. Harper, New York.

Crabtree, Don E.

1981 Archaeology. In *A Cultural Resources Overview of the Colorado Desert Planning Units* by Elizabeth von Till Warren, et al., pp. 25-54. U. S. Department of the Interior, Bureau of Land Management, California Desert District, Riverside.

Davis, Emma Lou, Kathryn H. Brown, and Jacqueline Nichols.

1980 *Evaluation of Early Human Activities and Remains in the California Desert.* Great Basin Foundation, San Diego.

Davis, James Thomas

1961 Trade Routes and Economic Exchange Among the Indians of California. *University of California Archaeological Survey Report, No. 54.* Berkeley.

Dobyns, Henry F., Paul H. Ezell, and Greta S. Ezell

1963 Death of a Society: the Halchidhoma. *Ethnohistory* 10(2):105-161.

Dongoske, Kurt, Mike Yeatts, T.J.Ferguson,, Leigh Jenkins, and Lynne Sebastian

1995 Historic Preservation and Native American Sites. *Society for American Archaeology Bulletin* 13(2):12-15.

Dorn, Ronald I.

1982 Observations of the Use of "Desert Varnish" in the Age-determination of Surfaces. *IVCM Newsletter* 10(2):2-5. Imperial Valley College, Barker Museum, El Centro.

Dorn, R. I. and T. M. Oberlander

1981 Microbial Origin of Desert Varnish. *Science* 213(11):1245-1247.

Dragovich, D.

1988 A Preliminary Electron Probe Study of Microchemical variation in Desert Varnish in Western South Wales, Australia. *Earth Surface Processes and Landforms* 13:259-270

Engle, E. G. and R. P. Sharp

1958 Chemical Data on Desert Varnish. *Geological Society of America Bulletin,* 60:487-518.

Ezell, Paul H.

1961 Malcolm J. Rogers 1890-1960. *American Antiquity* 26(4):532-534.

1984 A New Look at the San Dieguito Culture. *Casual Papers in Cultural Resource Management* 3(2):103-109.

Ezzo, Joseph A. and Jeffrey H. Altschul (compilers)
1993 Glyphs and Quarries of the Lower Colorado River. *Statistical Research Technical Series No. 44.* Tucson, Arizona.

Ferguson, T. J., Kurt Dongoske, Mike Yeatts, and Leigh Jenkins
1995a Hopi Oral History and Archaeology, Part I: The Consultative Process. *Society for American Archaeology Bulletin* 13(2):12-15.
1995b Hopi Oral History and Archaeology, Part II: Implementation. *Society for American Archaeology Bulletin* 13(3):10-13.

Forbes, Jack D.
1965 *Warriors of the Colorado: The Yumas of the Quechan Nation and Their Neighbors*. Norman, Oklahoma: University of Oklahoma Press.

Forde, C. Daryll
1931 Ethnography of the Yuman Indians. *Publications in American Archaeology and Ethnography* 28:83-278. University of California, Berkeley.

Harry, Karen G.
1995 Cation-ratio dating of varnished artifacts: testing the assumptions. *American Antiquity* 60(1):118-130

Hayden, Julian
1976 Pre-altithermal Archaeology in the Sierra Pinacate, Sonora, Mexico. *American Antiquity* 41:274-289.

Hester, Thomas R. and Robert F. Heizer
1973 *Bibliography of Archaeology I: Experiments, Lithic Technology and Petrographic Analysis*. Addison-Wesley.

Hester, Thomas R.
1978 *Archaeological Studies of Mesoamerican Obsidian.* Ballena Press, Socorro, N.M.

Hanna, David C.
1982 *Malcolm J. Rogers: The Biography of a Paradigm.* Masters thesis, Department of Anthropology, San Diego State University.

Howard, George W.
1985 The Desert Training Center/California-Arizona Maneuver Area. *Journal of Arizona History* 26(3):273-294.

Hughes, Richard E.
1986 *Diachronic Variability in Obsidian Procurement Paterns in Northeastern California and Southcentral Oregon.* University of California Press, Berkeley.

Jaeger, Edmund C.
1965 *The California Deserts, fourth edition.* Stanford University Press, Stanford, California.

Jenkins, O. P.
1962 *San Diego - El Centro Sheet*, Geologic map of California, Scale 1:250,000. California Division of Mines and Geology, Sacramento.

Johnson, Boma
1985 Earth Figures of the Lower Colorado and Gila River Deserts: A Functional Analysis. *The Arizona Archaeologist* 20. The Arizona Arcaheological Society, Phoenix.

Johnston, Francis J.
1980 Two Southern California Trade Trails. *Journal of California and Great Basin Anthropology* 2(1):88-96.

King, Thomas S. and David A. Phillips, Jr.
1996 Point-Counterpoint: More on TCPs amd Section 106. *Society for American Archaeology Bulletin* 14(1):13-21.

Kroeber, Alfred L.
1920 Yuman Tribes of the Lower Colorado. *University of California Publications in American Archaeology and Ethnology,* 16(8):475-485. Berkeley.
1925 *Handbook of the Indian of California.* Smithsonian Institution, Washington, D.C.

Kroeber, Clifton B. and Bernard L. Fontana
1986 *Massacre on the Gila. An Account of the Last Major Battle Between American Indians, with Reflections on the Origin of War.* University of Arizona Press, Tucson.

Lamb, Charles W.
1981 Tribal Positions and Oral Traditions Relative to Intaglios or Geoglyphs. *ASA Journal* 5(1): 43-49.

Laylander, Don
1995 The Chronology of Lake Cahuilla's Final Stand. *Proceeding of the Society for California Archaeology* 8:69-78.

Love, Bruce
1996 *Archaeology on the North Shoreline of Ancient Lake Cahuilla.* Prepared by CRM TECH, Riverside, California for U.S. Home Corporation, Tempe, Arizona.

Love, Frank

1974 *Mining Camps and Ghost Towns: A History of Mining in Arizona and California along the Lower Colorado.* Westernlore Press, Los Angeles.

McGuire, Randall H.

1982 Environmental Background. In *Hohokam and Patayan, Prehistory of Southwestern Arizona* edited by Randall H. McGuire and Michael B. Schiffer, pp. 13-56. Academic Press, New York.

McGuire, Randall H., and Michael B. Schiffer

1982 *Hohokam and Patayan, Prehistory of Southwestern Arizona.* Academic Press, New York.

McKenna, Jeanetta A.

1991 *Archaeological Investigations of the Proposed L.A. Cellular Tower at Iron Mountain, San Bernardino County, California.* McKenna et al. Whittier California.

1992 Historical/Military Archaeology in the Mohave Desert - The Desert Training Center, California/Arizona Maneuver Area. Paper presented at the 26th Annual Meeting of the Society for California Archaeology, Pasadena.

Meller, Sidney L.

1946 *The Army Ground Forces: The Desert Training Center and CAMA, Study No. 15.* Historical Section - Army Ground Forces.

Moratto, Michael J.

1984 *California Archaeology.* Academic Press, Inc., Orlando, Florida.

Morton, P. K.

1977 Geology and Mineral Resources of Imperial County, California. *California Division of Mines and Geology County Report* No. 7.

Parker, Patricia L and Thomas F. King

1992 Guidelines for Evaluating and Documenting Traditional Cultural Properties. *National Register Bulletin 38.* U.S.D.I. National Park Services, Interagency Resources Division, Washington, D.C.

Patton, Jr., George S.

1942 *The Desert Training Corps and Noptes on Tactics and Techniques of Desert Warfare.* Compiled and Edited by Charles M. Province, The Patton Historical Society.

Pendleton, Lorann

1984 *Archaeological Investigations in the Picacho Basin.* Report prepared by Wirth Environmental Services for San Diego Gas and Electric.

Quechan Indian Tribe

1989 Quechan Tribal Resolution and Statement of Position Concerning All-American Canal in Relation to Pilot Knob. Yuma Indian Reservation, Yuma.

Remy, Michael H., Tina A. Thomas, and James G. Moose

1992 *Guide to the California Environmental Quality Act (CEQA).* Solano Press Books, Point Arena, California.

Rogers, Malcolm J.

1928 Remarks on the Archaeology of the Gila River Drainage. *The Arizona Museum Journal* 1(1):21-24.

1929 Report on an Archaeological Reconnaissance in the Mojave Sink Region. *San Diego Museum of Man Papers* No. 1.

1938 Archaeological and Geological Investigations of the Cultural Levels in an Old Channel of San Dieguito Valley. *Carnegie Institution of Washington Year Book.* 37:344-345.

1939 Early Lithic Industries of the Lower Basin of the Colorado River and Adjacent Areas. *San Diego Museum of Man Papers* No. 3.

1945 An Outline of Yuman Prehistory. *Southwestern Journal of Anthropology* 1(2):167-198.

1958 San Dieguito Implements from the Terraces of the Rincon-Pantano and Rillito Drainage System. *The Kiva* 24(1):1-23.

1966 *Ancient Hunters of the Far West.* Union-Tribune, San Diego.

Schaefer, Jerry

1985a *Preliminary Field Report of Cultural Resources, Testing and Data Recovery, Gold Fields - Mesquite Project.* Report prepared by Mooney-Lettieri and Associates for Gold Fields Mining Corporation, 200 Union Blvd. Ste. 500, Lakewood, CO 80228.

1985b *Cultural Resources of Pilot Knob, Results of an Intense Linear Survey.* Prepared for Bureau of Reclamation, Lower Colorado River Office by ASM Affiliates.

1987 *Hunter-Gatherer Adaptations to a Marginal Desert Environment, Subsistence Practices and Lithic Production in the Chocolate Mountains, Imperial County, California.* Report prepared by Mooney-LeVine and Associates, Inc. for Gold Fields Mining Corporation, Lakewood, Colorado.

1993 *White Tanks Archaeological District, National Register of Historic Places Registration Form.* Prepared by Brian F. Mooney Associates for the U.S. Army Corps of Engineers, Los Angeles District.

1994a The Challenge of Archaeological Research in the Colorado Desert: Recent Approaches and Discoveries. *Journal of California and Great Basin Anthropology* 16 (1): 60-80.

1994b The Stuff of Creation: Recent Approaches to Ceramics Analysis in the Colorado Desert. In *Recent Research Along the Lower Colorado River*, edited by Joseph A. Ezzo, pp. 81-100. Statistical Research Technical Series No. 51, Tucson.

Schaefer, Jerry, Ken Hedges, Diane L. Hamann, and M. Steven Shackley

1993 *Hunter-Gatherer Settlement, Subsistence and Symbolism at White Tanks, Yuma Proving Ground, Arizona.* Prepared for the U.S. Army Corps of Engineers, Los Angeles District by Brian F. Mooney Associates.

Schaefer, Jerry and Drew Pallette

1991 *Cultural Resource Survey and Assessment of the BEMA Indian Rose Project Area.* Report prepared by Brian F. Mooney Associates for Imperial Gold, Vancouver, BC.

1993 *Results and Recommendations of a Class III Cultural Resource Inventory of the Proposed Mesquite Regional Landfill Project Area, Imperial County, California. Volume I, Technical Report.* Prepared by Brian F. Mooney Associates for Environmental Solutions, Inc., Irvine, California.

Schroeder, Albert H.

1975 The Hohokam, Sinagua and the Hakataya. *Imperial Valley College Occasional Paper No. 3.* El Centro, California.

1979 Prehistory: Hakataya. In *Handbook of North American Indians, Volume 9, Southwest,* edited by Alfonso Ortiz, pp. 100-107. Smithsonian Institution Press, Washington, D.C.

Schultz, Paul L.

1949 *The 85th Infantry Division in World War II.* Infantry Journal Press, Washington, D.C.

Sebastian, Lynne

1995 Letter to the Editor. *Society for American Archaeology Bulletin* 13(3):3.

Shackley, M. Steven

1988 *Prehistoric Lithic Technology and Production in the Southern Chocolate Mountains: Data Recovery and Analysis at Mesquite Mine, Imperial County, California.* Report prepared by Brian F. Mooney, Associates for Gold Fields Operating Company.

1994 Intersource and Intrasource Geochemical Variability in Two Newly Discovered Archaeological Obsidian Sources in the Great Basin. *Journal of California and Great Basin Archaeology* 16(1):118-129.

Sharp, Robert P.
1972 *Southern California Field Guide.* Kendall/Hunt Publishing, Dubuque.

Solari, Elaine Maryse and Boma Johnson
1982 Intaglios: A Synthesis of Known Information and Recommendations for Management. In *Hohokam and Patayan, Prehistory of Southwestern Arizona*, edited by Randall H. McGuire and Michael B. Schiffer, pp. 417-432. Academic Press, New York.

Taylor, R. E. and Louis A. Payen
1979 The Role of Archaeometry in American Archaeology. In *Advances in Archaeological Method and Theory, Vol. 2,* edited by Michael B. Schiffer, pp. 239-285. Academic Press, New York.

Thompson, Robert
1968 Tidal flat sedimentation of the Colorado River delta, northwestern Gulf of California. *Geological Society of America Memoir* 107.
1984 Past Environment. In *Archaeological Investigations in the Picacho Basin,* by Lorann Pendleton. Report prepared by Wirth Environmental Services for San Diego Gas and Electric.

Van Devender, Thomas and Geoffrey Spaulding
1979 Development of Vegetation and Climate in the Southwestern United states. *Science* 204 (4304): 701-710.

Vaughan, Sheila J.
1982 *A Replicative Systems Analysis of the San Dieguito Component at the C. W. Harris Site.* Masters Thesis, Department of Anthropology, University of Nevada, Las Vegas.

von Werlhof, Jay
1984a *Archaeological Investigations of the Gold Fields Mesquite District.* Report prepared by the Imperial Valley College Museum for Gold Fields Mining Company, Inc.
1984b *Archaeological Examinations of the Mesquite District Northwest.* Report prepared by the Imperial Valley College Museum for the Gold Fields Mining Company, Inc.
1984c *Archaeological Investigations of Gold Fields Indian Pass Project Area.* Report prepared by the Imperial Valley College Museum for Gold Fields Mining Company, Inc
1987 *Spirits of the Earth, A Study of Earthern Art in the North American Deserts, Volume I: The North Desert.* Imperial Valley College Museum, El Centro, California.

von Werlhof, Jay and Sherilee von Werlhof

1977 *Archaeological Examinations of Certain Portions of Chocolate Mountains.* Report prepared by the Imperial Valley College Museum for the U.S. Naval Weapons Center, China Lake, California.

Vredenburgh, Larry M., Gary Shumay, and Russell Hartill

1981 *Desert Fever.* An Overview of Minning in the California Desert Living West Press, Canoga Park, California.

Warren, Claude N.

1967 The San Dieguito Complex, a Review and Hypotheses. *American Antiquity* 32(2): 168-185.

Warren, Claude N. and D.L. True

1961 The San Dieguito Complex and Its Place in California Prehistory. *Archaeological Survey Annual Report* 1960-61. pp. 246-338. Department of Anthropology and Sociology, University of California, Los Angeles.

Waters, Michael R.

1982a The Lowland Patayan Ceramic Tradition. In *Hohokam and Patayan*, edited by Randall H. McGuire and Michael B. Schiffer, pp. 275-298. Academic Press, New York.

1982b The Lowland Patayan Ceramic Typology. In *Hohokam and Patayan*, edited by Randall H. McGuire and Michael B. Schiffer, pp. 537-570. Academic Press, New York.

1982c Trail Shrine at Site SDM C-1 (based on the notes of Malcolm J. Rogers). In *Hohokam and Patayan, Prehistory of Southwestern Arizona*, edited by Randall H. McGuire and Michael B. Schiffer, pp. 533-535. Academic Press, New York.

1984 The Geomorphology of the Transmission Line Corridor, Picacho Basin, California. In *Archaeological Investigations in the Picacho Basin,* by Lorann Pendleton, Appendix G. Report prepared by Wirth Environmental Services for San Diego Gas and Electric.

Weide, David C.

1976 Regional Environmental History of the Yuha Desert. In *Background to Prehistory of the Yuha Desert Region,* edited by P. J. Wilke, pp. 9-20. Ballena Press Anthropological Papers 5.

Weide, Margaret

1976 A Cultural Sequence for the Yuha Desert. In *Background to Prehistory of the Yuha Desert Region,* Philip J. Wilke, ed., pp. 81-94. Ballena Press Anthropological Papers 5.

Weigand, Phil C. and Garman Harbottle

1992 The Role of Turquoise in the Ancient Meso American Trade Structure. In The American Southwest and Mesoamerica: *Systems of Prehistoric Exchange*, edited by Jonathon E. Ericson and Timothy G Baugh. Plenum Press, New York.

Weight, Harold O.

1949 Rockhound Trail to Indian Pass. *The Desert Magazine* 12(4):16-21.

Wilke, Philip J.

1976 *Background to Prehistory of the Yuha Desert.* Ballena Press Anthropological Papers No. 5. Ramona.

1978 *Late Prehistoric Human Ecology at Lake Cahuilla, Coachella Valley, California.* Contributions of the University of California Archaeological Research Facility Number 38. University of California, Berkeley.

Wilke, Phillip J. and Adella B. Schroth

1989 Lithic Raw Material Prospects in the Mohave Desert, California. *Journal of California and Great Basin Anthropology* 11(2):146-174

APPENDIX J-2 - A SUPPLEMENTAL CULTURAL RESOURCES INVENTORY AND EVALUATION OF THE POWER SUPPLY ROUTE FOR THE IMPERIAL PROJECT, IMPERIAL COUNTY, CALIFORNIA

A SUPPLEMENTAL CULTURAL RESOURCES INVENTORY AND EVALUATION OF THE POWER SUPPLY ROUTE FOR THE IMPERIAL PROJECT, IMPERIAL COUNTY, CALIFORNIA.

VOLUME I
TECHNICAL REPORT

Prepared for:

Chemgold, Inc.
P.O. Box 758
Winterhaven, California 92283

Prepared by:

ASM Affiliates, Inc.
543 Encinitas Blvd., Suite 114
Encinitas, California 92024
619-632-1094

Jerry Schaefer, Ph.D.
Principal Investigator

Ken Victorino, M.A.
Associate Archaeologist
September 1996

USGS Quadrangle: Hedges, Calif. 1984, 7.5'
Acreage: 17 linear miles
Project Type: Intensive Pedestrian Survey
Key Words: Colorado Desert, Cargo Muchacho Mountains, Trails, Geoglyphs, Ceramic Scatters, Lithic Scatters, Historic Mining

TABLE OF CONTENTS

Volume I - Technical Report

MANAGEMENT SUMMARY ii

Chapter — Page

I. INTRODUCTION 1
PROJECT DESCRIPTION 1
RECORD SEARCH AND FIELD METHODS 3

II. RESULTS 4

III. SIGNIFICANCE EVALUATION, IMPACT PROJECTIONS, AND MITIGATION RECOMMENDATIONS 7

IV. REFERENCES 13

LIST OF FIGURES

Figure — Page

1. Project location map 2

LIST OF TABLES

Table — Page

1. Previously Recorded Sites Within Survey Area 5

Volume II - Confidential Map and Site Records

Figure

1. Location of Previously Recorded and Newly Recorded Sites 1

MANAGEMENT SUMMARY

A cultural resources inventory was undertaken of a portion of Indian Pass Road and the proposed 17 mile power supply route for the Chemgold's Imperial Mine project. This report is a supplement to the cultural resources inventory and evaluation undertaken for the proposed mine, providing data for compliance with the National Historic Preservation Act (36 CFR 800) (Schaefer and Schultze 1996). This study treats previously recorded and newly discovered archaeological sites along Indian Pass Road between Ogilby Road and the existing Imperial Irrigation District (IID) 34.5 kV transmission line, and along the existing IID line between Indian Pass Road and Interstate 8 along the west side of the Cargo Muchacho Mountains for 16 miles to the south. A records search and intensive pedestrian survey revealed 16 sites and two isolates along the route. Four of the previously recorded sites could not be relocated due to either subsequent disturbance or insufficient location data on site records. The site inventory includes four geoglyph sites with associated trails and artifact scatters, seven prehistoric and historic trail segments, one lithic scatter, one ceramic scatter, one historic mining sites, and two recent historic rock alignments. Two isolated chert flakes were also recorded. The four geoglyph sites, two of the trails, and the historic mining site are evaluated as significant and therefore potentially eligible for the National Register of Historic Places. One trail and one ceramic scatter that could not be relocated are evaluated as indeterminate. The remaining seven sites and two isolates are evaluated as not National Register eligible. The geoglyphs are also evaluated as significant for Native American Religious values and Native American consultation is recommended for further treatment of these sites. No direct impacts are projected at any of the sites except for five ceramic scatters at three sites (CA-IMP-3297H, -4131, and -7276). Data recovery is recommended for these ceramic scatters. Fencing and monitoring are recommended to avoid indirect impacts at the geoglyphs sites and some of the trails.

I. INTRODUCTION

This report presents the results of a supplemental cultural resource survey conducted by ASM Affiliates, Inc. as part of the Chemgold Imperial Project. Brian F. Mooney and Associates and ASM Affiliates, Inc. conducted an intensive pedestrian survey and cultural resource inventory of the 2,212 acre Chemgold Imperial Mine Project in 1991 and 1995. The results are documented in *Cultural Resources of Indian Pass: An Inventory and Evaluation for the Imperial Project, Imperial County, California*, prepared by ASM Affiliates, Inc. (Schaefer and Schultze 1996). The reader is referred to that report for a complete discussion of previous research in the area, environmental and cultural setting, and the criteria for making significance evaluations.

PROJECT DESCRIPTION

To deliver power to the Imperial Project, an existing Imperial Irrigation District (IID) 34.5 kV transmission line, built in 1964, would be "overbuilt" with a new 92 kV transmission line to also be owned by IID. The surveyed area also includes a one mile stretch of Indian Pass Road near Ogilby Road east to the exiting IID line that would be realigned approximately 330 feet to the south so the two roads could intersect at more of a right angle rather than the present acute angle. The surveyed transmission line route begins at Indian Pass Road and proceeds approximately 16 miles south skirting the west side of the Cargo Muchacho Mountains to Sidewinder Road and Interstate 8 (Figure 1). This new 92 kV/34.5 kV transmission line would be connected to the existing IID 92 kV "C-line" at a location immediately south of Interstate 8. At the point where the existing 34.5 kV transmission line crosses Indian Pass Road (approximately 4.5 miles southwest of the Project mine and process area), a new electrical metering station would be constructed and owned by the Project. From the metering station, a new 92 kV transmission lines, also owned by the Project, would be built adjacent to the south side of Indian Pass Road to a mine substation located within the Project mine and process area. A 7.2 kV distribution line would be "overbuilt" on the same poles as the new 92 kV transmission line running adjacent to Indian Pass Road to provide power as necessary to the ground water well pumps located adjacent to Indian Pass Road in the Project ancillary area.

The metering station would be built within a fenced area approximately 25 feet by 50 feet located southeast of the intersection of the existing 34.5 kV transmission line and Indian Pass Road. The mine substation would be enclosed within the similarly sized fenced area among the Project facilities located near the northwest corner of the heap leach pad.

The process of "overbuilding" the exiting 34.5 kV transmission line entails: (1) tilting the existing wooden poles to the side to move the electrical conductors out of the current transmission line alignment; (2) installing new, taller, wooden poles in the same transmission line alignment; (3) installing the new 92 kV conductors near the top of the poles; (4) moving the existing 34.5 kV conductors from the existing poles to below the 92 kV conductors on the new poles; and (5) removing the existing poles.

The 92 kV/34.5 kV transmission line would be constructed within the 20-foot wide right-of-way granted by the BLM and the easements obtained from the private landowners near Interstate 8 for the existing transmission line. Construction access would be from the existing transmission line access road, which roughly parallels the entire length of the transmission line. To tilt and remove the existing

poles, the short trails from the access road to each existing pole and the areas around each existing pole which were disturbed when the transmission line was originally installed in 1964 will be redisturbed.

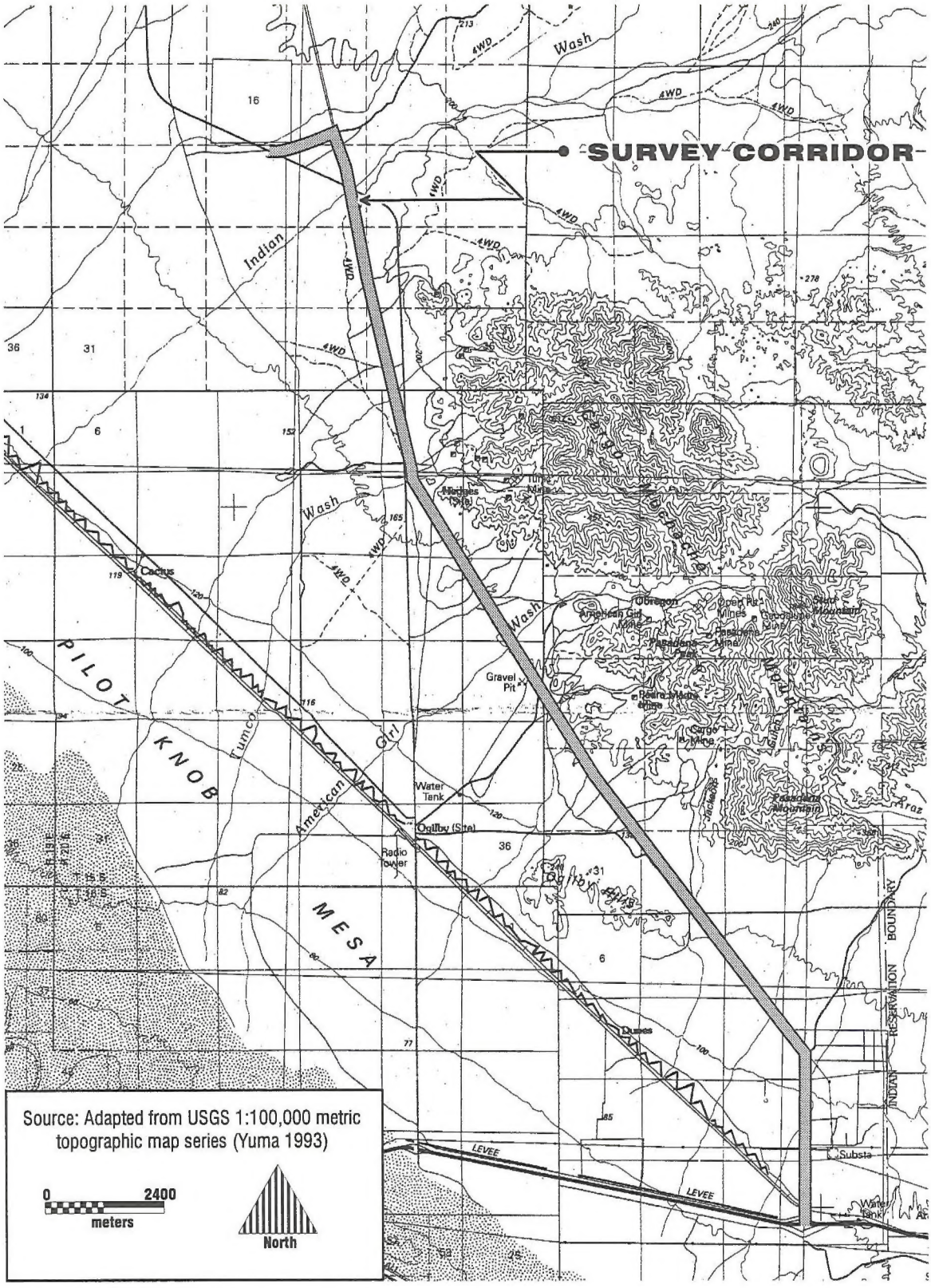


Figure 1. Project location map

However, spacing of the approximately 280 new poles may be reduced to approximately 300 feet from the existing spacing of 400 feet, which would require the disturbance of short trails from the existing access road to each new pole, as well as disturbance of the area around each new pole. Additional surface disturbance within a 100-foot square area will also occur when the existing and new conductors are "pulled" from approximately nine cable pulling stations, and from equipment laydown areas to be established at each end of the transmission line. It is estimated that approximately 21 acres will be disturbed during construction.

RECORD SEARCH AND FIELD METHODS

Under the direction of Jerry Schaefer, Ph.D., (Principal Investigator) the supplemental cultural resource survey was conducted over a three day period, September 4-6, 1996, by Ken Victorino (field supervisor), Stephanie Barker, Barb Giacomini, Shannon Hamilton. A record search covering an area one-half mile beyond the project boundary was first conducted at the Southeast Information Center (located in the Imperial Valley College Desert Museum, Ocotillo) on September 3, 1996, prior to the survey.

Information for new sites and isolates, including type, description, location, disturbance/integrity, and topography, was documented. Site/isolate location was plotted on a 7.5 minute USGS quadrangle map, a map of the site showing topography and any distinguishing features (such as transmission line poles) was sketched, and photographs of the site and surrounding area were taken. No artifacts were collected. Previously recorded sites within the survey area were relocated, if possible, and evaluated for accuracy of site forms and changes since the last investigations.

Previously recorded sites within the project right-of-way are included in Volume II of this report, along with new site forms for newly discovered sites and supplements to existing site forms when new information was collected for previously recorded sites. The site records for the one-half mile areas on either side of the survey corridor are on file at ASM Affiliates.

A pre-existing transmission line corridor about 100 feet wide and 16 miles long, beginning at the intersection of the Imperial Irrigation District (IID) 34.5 kV transmission line with Indian Pass Road and ending at its interconnection with the IID "A" line immediately south of Interstate 8 was examined during the supplemental survey (Figure 1). This strip was surveyed using 15 foot intervals between surveyors and covered an area 50 feet on either side of the transmission line centerline. An additional 650 foot wide strip along Indian Pass Road (150 feet north of the road and 500 feet south) was surveyed from its intersection with Ogilby Road to the point Indian Pass Road runs under the IID 34.5 kV transmission line. This section, approximately one mile in length, was surveyed at 75 foot intervals. Access road and transmission line construction, along with off-road vehicles contributed to the high level of disturbance within the survey area. Visibility was good throughout the entire area. The remaining transmission line corridor along Indian Pass Road between the exiting IID transmission line and the Project mine and processing area was surveyed as part of the previous inventory with regard to improvements to Indian Pass Road (Schaefer and Schultze 1996).

II. RESULTS

The record search at the Southeast Information Center revealed that the study area had been the subject of a previous study. In 1994, Western Cultural Resource Management (Farmington, New Mexico) conducted the Western Area Power Administration Blythe-Knob 161 kV Transmission Line Class III Cultural Resource Inventory. This investigation surveyed the 161 kV twin-pole "H"-frame transmission line which parallels and is just east of the 34.5 kV single pole transmission line for most of its length. Several of the sites found within the present survey area were recorded at this time.

During the current study, 11 of the 15 sites previously recorded within the survey area were relocated and evaluated for the accuracy and adequacy of the existing site record. They are summarized in Table 1 and the detailed site records for each appear in the confidential Volume II, along with the map showing their locations along the transmission line route (Volume II, Figure 1). The 1994 site records were found to be extremely good although earlier records tended to have inadequate location information. Two sites, IMP-6661 and -3297/H, were updated when additional artifact scatters were discovered. The previous site boundary of IMP-6661 was extended approximately 40 m east to include two new lithic scatters with a total of 41 predominantly interior, chert flakes. IMP-3297/H, a trail with three pieces of associated pottery, continued to the south beyond the previous recording and included five additional ceramic scatters with 60+ sherds. The remaining four sites were not relocated probably due to erosion, access road widening, collection, or imprecise mapping.

Two new sites and one isolate were recorded (see Table 1). The first site, temporarily designated site 96-2, is a rock ring located south of Indian Pass Road and west of the IID 34.5 kV transmission line. Approximately 20 lightly embedded, granite and metavolcanic rocks compose the ring. The rocks in the south half are light colored while the rocks in the north half are dark colored, giving the ring the appearance of a geoglyph or marker, but of recent historic date. In the center of the 3m diameter ring is a pile of about five rocks. Charcoal and aluminum foil scraps were found loosely imbedded inside the rock ring. Several modern fire rings are in the adjacent area. Site 96-3 is a j-shaped configuration of rock approximately 5m long and 2.5m wide. The arrangement, approximately 25m west of Sidewinder Road, includes about 50 granite and metavolcanic rocks of varying size. A small pile of dark river pebbles from the surrounding desert pavement is in the hook section of the "J." Pieces of broken brown and green glass along with rusted bottle tops are nearby indicating recent historic origins. Finally, 96-I1 is an isolated chert flake. Approximately 25m west of Sidewinder Road, the mustard-colored flake is lightly embedded in a flat desert pavement of small river pebbles.

Table 1. Previously Recorded Sites Within Survey Area

Site Designation	Site Type/ Description	Artifacts	Relocated (yes/no)	Comments	Signifi-cance
IMP-6661	Two geoglyphs, rock alignment, cleared circle, "shaman's hearth," and associated lithics	One utilized red jasper flake and one red chert biface scraper	yes	Site update. Two newly recorded lithic scatters, totaling 40+ flakes, extend previous site boundary. The anthropomorphic geoglyph is questionable. Site will be impacted during transmission line reconstruction.	Y
96-2	Rock ring -- composed of approx. 20 granite and metavolcanic rocks. Five rocks are piled in the center of the 3m diameter ring.	None		Aluminum foil scraps found loosely embedded inside rock ring. Several modern fire rings in adjacent area.	N
IMP-4131	Geoglyph, two cleared circles, one quartz flaking station, and a ceramic concentration	Approximately 75 - 100 body sherds and one rim. One core fragment and seven flakes.	yes	Cleared circles (which are vague) and geoglyph	Y
IMP-1469T	Trail	None	no	Site record lacking. No site map and poor site description.	I
IMP-7272T	Trail	None	yes	"Site has been heavily impacted...lack of artifacts suggests that little information can be acquired" according to 1994 record.	N
IMP-7273T/H	Three trail segments and an historic component	No prehistoric artifacts.	yes	Historic component will **not** be impacted. According to 1994 site record "further investigation is need to determine if apparent tent clearings may be related to mining activity."	N
IMP-3297/H	Ceramic scatter with associated trail	Two body sherds and one rim sherd (Tumco buff)	yes	Site update. Five new ceramic scatters (60+ sherds) were recorded along the identified trail, which continues to the south. Only two scatters, containing less than 10 sherds will be impacted during transmission line reconstruction.	Y
IMP-7274T	Trail	None	yes	According to 1994 recording "site retains the potential to provide information...even though the trail is heavily impacted."	Y
IMP-1471T	Trail	None	no	Site record lacking. No site map and poor site description.	I
IMP-7275T	Trail	None	yes	"Trail is heavily impacted and retains little potential to provide new information" according to 1994 site record.	N
IMP-7191 I	One brown chert flake, unifacially retouched into a scraper		yes	Will be impacted.	N
IMP-7339	Ceramic scatter	45 sherds (Palomas Red-on-buff)	no	Possible access road widening (site was recorded as being 1.5m away from road in 1994) and erosion due to seasonal drainage west of the site may be responsible for difficulty in relocation. "Can provide little new information" according to 1994 site record.	I

Site Designation	Site Type/ Description	Artifacts	Relocated (yes/no)	Comments	Signifi-cance
IMP-7276T	Trail segment, possible geoglyph, and pot drop	40 bowl sherds, two of which are rim fragments	yes	Impact possible during reconstruction. According to 1994 record "site can provide additional information concerning a wide variety of research questions."	Y
IMP-7269/H	Historic dump, possible hearth, trail segment, and possible geoglyph	Hole-in-cap cans with soldered side seams and hand-finished bottle fragments	yes	Geoglyph is questionable. Only a small portion of the site will be impacted by transmission line reconstruction. A BLM archaeologist, who visited the site, suggested that "the possible geoglyph was caused by dragging a heavy object and that the historic materials lacked integrity" according to the 1994 site record.	Y
IMP-2878	Geoglyph with ceramic concentrations and lithic scatter	Three distinct pot drops containing a total of 111 body sherds	yes	According to site record, Boma Johnson (Arizona BLM archaeologist) suggested that "the geoglyph may represent a ceremonial pathway or procession way." Geoglyph should **not** be impacted during reconstruction.	Y
96-I1	Isolated chert flake				N
96-3	Rock arrangement -- 50 granite and metavolcanic rocks in the shape of a "j," about 5m long and 2.5m wide. Small pile of dark river pebbles (from surrounding desert pavement) in the hook section of the "j."	None		Broken brown and green glass along with rusted bottle tops nearby.	N
IMP-7340	Lithic scatter	7 pieces of angular chert debris	no	1994 site description and site map places lithic scatter **in** transmission line access road. "Only minimal information can be gained" according to record.	N

III. SIGNIFICANCE EVALUATION, IMPACT PROJECTIONS, AND MITIGATION RECOMMENDATIONS

The following evaluation treats each of the sites recorded within the transmission line, area of potential effect (APE). Evaluations are also summarized in Table 1. Sites are discussed above in Table 1 in the order that they occur, starting at the north end of the transmission line route at Indian Pass Road and proceeding south to Interstate 8. Significance criteria for assessing National Register eligibility are discussed in detail in the Imperial Mine Inventory report to which this is a supplement (Schaefer and Schultze 1996).

Seven sites are evaluated as significant and therefore potentially eligible for the National Register based on criterion "D." These include CA-IMP-6661, -4131, -3297/H, -7274T, -7276, -7269/H, and -2878. In addition, four or five of these sites (CA-IMP-6661, -4131, -7276, possibly 7269/H, and -2878) contain geoglyphs or possible geoglyphs with potential Native American religious values. In every case, the geoglyphs are in portions of the sites outside the transmission line APE or can be avoided through fencing and monitoring procedures. At three sites (CA-IMP-3297/H, -4131, and -7276), recovery of five ceramic scatters is recommended because of their proximity to the access road or location within the APE. Native American consultation is recommended to supplement this significance evaluation and to develop appropriate mitigation measures.

Seven sites are evaluated as not significant or National Register eligible. They are either too recent in date (CA-IMP-7273/H, 96-2, 96-3), too disturbed (CA-IMP-7272T, 7275T), or are very small lithic scatters with little research potential (CA-IMP-7340). Two recorded isolates are de facto not significant. Three previously recorded sites could not be relocated and are evaluated as indeterminate.

IMP-6661

This complex of two geoglyphs with associated isolated artifacts, rock alignment, cleared circle, and hearth feature are significant under criterion "D" and also for Native American religious values. The original recorder called a small rock ring a "shaman's hearth" but this is a subjective interpretation. It is associated with the geoglyphs, however, and is a significant element of the complex. The anthropomorphic geoglyph is impacted by vehicle tracks but otherwise the complex is in good condition. Located only 36 m north of Indian Pass Road and very close to the intersection with Ogilby Road, the geoglyph complex is possibly subject to potential indirect impacts associated with the realignment of the Indian Pass Road-Ogilby Road intersection approximately 330 feet to the south (away from IMP-6661). It is recommended that Native American consultation first be undertaken regarding protection of this site. It is also recommended that temporary fencing be placed around the geoglyph complex prior to construction to prevent indirect impacts. The fencing should be placed far enough away from the geoglyphs to avoid impacts and be of a type that does not disturb the desert pavement. The fencing should then be removed following construction.

SITE 96-2

This newly recorded rock ring is composed of widely spaced cobbles and boulders on late Holocene gravel pavement. There are five light gray granitic cobbles piles in the center. An unusual aspect of the rock ring is that the southern half of the rock ring is composed entirely of light gray granitic boulders while the northern half is composed of varnished dark brown boulders. All of the rocks are either directly above or lightly embedded in the desert pavement. Aluminum foil scraps found embedded in the rock ring and its location at the juncture of Indian Pass road and the transmission line suggest this is a recent historic or modern feature, possibly a landmark. This site is evaluated as not significant because of its apparent recent age.

IMP-4131

This complex of a geoglyph, cleared circles, a pottery scatter, and a few isolated flakes and sherd is located within the transmission line APE and just west of the bladed access road. It is evaluated as significant under criterion "D' and also for Native American religious values. The Palomas Buff sherds, if associated with the other features, tentatively date the site to the Patayan II phase (A.D. 1000-1700) or Patayan III phase (A.D. 1700-1940). The site has already experienced extensive impacts from the access road and some heavy machinery use but the ceramics and geoglyph persist. Direct impacts to the sherd scatter are possible and there is the potential for indirect impacts to the cleared circles and the geoglyph. First Native American consultation should be undertaken regarding the significance evaluation and protecting the site. The sherds in the APE should be collected and analyzed with regard to confirming the ceramic type and reconstructing the shape to better establish the date and cultural association. The Quechan Cultural Center is the recommended curation facility for the sherds. Temporary fencing should be placed around the geoglyph complex prior to construction to prevent indirect impacts. This should be placed far enough away from the geoglyphs to avoid impacts and be of a type that does not disturb the desert pavement. The fencing should then be removed following construction.

IMP-1469T

This 60 m long northwest-southeast trending trail segment was reported in 1977 in association with the transmission line road but without a location map or other documentation. The orientation of the trail leading into the Cargo Muchacho Mountains suggests that it is associated with historic mining activities but it may also be prehistoric and was connected with the important trail, IMP-5359T, that leads to Indian Pass or with activities in the Cargo Muchacho Mountains. No trace of the trail was found in the project area and it is likely that it was destroyed subsequent to the transmission line construction. The site is therefore evaluated as indeterminate unless it is relocated in the future.

IMP-7272T

This 110 m long, east-west trending trail segment is bisected by the transmission line corridor, access road, Ogilby Road, and several erosional features. The orientation suggests it led up one of the major washes into the Cargo Muchacho Mountains. Although Patayan ceramics were found in association when first recorded in 1977, no artifacts remain and only a few portions of the trail remain preserved. The site is therefore evaluated as not significant.

IMP-7273/H

This site includes three tent clearings with hearth and historic rock alignments that form the initials "R.A." that are probably not related with the historic mining town of Hedges/Tumco. The apparent recent date and lack of historic artifacts indicate the site is therefore not significant. The initials may date to the mine but the clearings appear to be of more recent date. All of these are located at least 75 m east of the APE. Three trails occur nearby, two of which are bisected by the transmission line and one of which runs parallel some 20-40 m east of the APE. The trails do not appear to be associated with historic mining activities but may be outliers. The complex is not physically connected to the larger Hedges/Tumco site (IMP-3279H) and probably post-dates it.

IMP-3297/H

This trail with associated Patayan ceramic scatters is oriented in a northeast-southwest direction, leading into the Cargo Muchacho Mountains and the mining site of Hedges/Tumco. Because of the large number of ceramics and associations with Hedges/Tumco, the site is evaluated as significant under criterion "D." A small ceramic scatter was previously recorded outside the transmission line APE to the north and five additional scatters containing more than 60 sherds were recorded in areas just north of the transmission line and in extensions of the trail south of the project APE. The trail may be a prehistoric Patayan trail system leading into the Cargo Muchacho Mountains. Some of the major washes in the Cargo Muchacho Mountains may have supported some desert riparian habitats with plant and animal resources of interest to Native Americans. However, the Cargo Muchacho Mountains appear to have been marginal compared to other areas. It is also possible that the ceramics date to the late 19th or early 20th century during the time of historic mining at Hedges/Tumco. Analysis of traditional Patayan ceramics from the historic mining site demonstrate that Quechan ceramics were being sold or traded to miners for water storage and cooking vessels. The Quechan were also modifying some of their vessel forms to imitate late Victorian era cups, saucers, and pitchers (Schaefer 1993). The date of these ceramics would have to be determined by examining temper characteristics, rim form, and shape to see if they typify this historic Quechan ceramic tradition. If the ceramics were found to be contemporary with Hedges/Tumco, these finds may suggest that Quechan were traveling directly to the mining camps to trade their ceramics rather than conducing business in Yuma or through middlemen merchants. Some of the pottery may also have been dropped by Mexican or Anglo miners. In either case, the trails and ceramics have the potential to address questions of economic and cultural influences between Quechan and Euro-American peoples at the turn of the century.

Two of the ceramic scatters and a newly recorded segment of trail are likely to be impacted by transmission line construction. Data recovery is recommended for these scatters. No additional impacts are projected for ceramic scatters outside the APE although measures should be taken to ensure that no indirect impacts occur in this location and that any proposed staging areas avoid this location.

IMP-7274T

This northeast-southwest trending trail segment connects with the main historic access road to Hedges/Tumco. It was previously interpreted as a secondary access route to the mining community. It is evaluated as significant under criterion "D" because it provides additional information on the transportation and communication network associated with the National Register eligible site of Hedges/Tumco (IMP-3297H). The transmission line APE bisects the trail and it has already been severely impacted by an existing graded area under the transmission line. No additional impacts are projected.

IMP-1471T

This northeast-southwest trail segment was originally recorded in 1977 but with no location map or additional information. Due to the lack of evidence, the trail assigned this number and given this location is evaluated as indeterminate. It could not be relocated during the present survey and may either no longer exist due to erosion, or due to the quality of maps available at that time, may actually be mismapped. It is possible that it is actually one of the other trails recorded just to the north or south. Site records for the next trail south suggest that this early site record may actually refer to site IMP-7275.

IMP-7275

This northeast-southwest oriented trail has no associated artifacts and was previously recorded as a prehistoric trail segment. It is evaluated as not significant because of the poor preservation and lack of associated artifacts. It leads into American Girl Wash and may have provided access to the riparian resources in this area of the Cargo Muchacho Mountains. Alternatively or in addition, it may also have been an historic trail leading to the American Girl Mine that was active at the turn of the century (Hector et al. 1991). That portion of the trail within the project APE is substantially impacted by heavy equipment disturbance. No additional impacts are projected from the current project.

IMP-7191-I

A single isolated brown chert flake with evidence of unifacial retouch lies directly in the transmission line APE. Most isolates such as this are *de facto* not significant or National Register eligible. Although the lithic may be directly impacted, not further investigations are recommended.

IMP-7339

This pot drop consisting of two scatters of Palomas Red-on-Buff ceramic was recorded in 1994 just west of the transmission line access road. Because the ceramic scatter could not be relocated, it is evaluated as indeterminate. It may have been either recovered or displaced during access road widening or displaced by erosion. We disagree with the original assessment that it is not significant. Decorated Patayan ceramics are extremely rare and this reconstructed vessel could provide information on Patayan chronology and ceramic traditions, making it potentially significant under criterion "D." Decoration became more common in the ethnohistoric period and this vessel may have been manufactured for Mexicans or Euro-americans as well.

IMP-7276

A site composed of a trail segment, geoglyph, and ceramic scatter are located just west of the transmission line right-of-way. The site is evaluated as significant under criterion "D" and also for possible Native American values. The geoglyph is a 4-meter diameter circle tamped into the desert pavement. It is interpreted as a possible dance circle but this is a preliminary interpretation subject to further investigation because of its small size. Native American consultation is advised in this matter. It is located 40 m west of the transmission line centerline. The pot drop of 40 sherds is located only 2 m west of the access road. These consist of Palomas Red-on-buff sherds. The site is located in an area of substantial previous disturbance from off-road activity and erosion. Prior to Native American consultation on the matter, some mitigation recommendations can be made. Indirect impacts to the geoglyphs can be avoided by erecting temporary fencing and/or signs to direct construction vehicles to stay on approved access roads. The pot drop is located so close to the road that data recovery and analysis are recommended. The trail has already been directly impacted by erosion and heavy equipment within the project APE. No additional impacts are projected.

IMP-7269/H

This site includes four historic trash dumps, hearth, and historic artifact scatter associated with the turn of the century mining activity that was so prevalent in the Cargo Muchacho Mountains. The two ceramic sherds may also be historic or from historic Quechan ceramics sold to miners. Underlying this heavily disturbed area are wheat previous recorded suggest is a possible geoglyph. This area is so disturbed that it is difficult to access this feature and it may likely have resulted from historic activities. A small segment of what may have been a prehistoric trail also occurs at the north end of the site. The historic trash dumps and artifact scatter contain enough information to contribute to our understanding of historic mining lifeways and foodways. They are therefore evaluated as significant under criterion "D." The possible prehistoric elements appear to be so impacted as to have limited significant under criterion "D." Native American consultation should be undertaken to access possible religious values. In either case, the site lies outside the transmission line corridor although access roads are located immediately to the west of the complex. No direct impacts are therefore projected. Indirect impacts can be avoided through signing and temporary markers or fencing to prevent inadvertent off-road activity.

IMP-2878

This site is a geoglyph complex with associated quartz chipping stations and scatters, and three ceramic scatters. It is evaluated as significant under criterion "D" and also for Native American religious values. The geoglyph and one of the sherd scatters is located to the north of the transmission line right-of-way and a secondary bladed road that is not part of the original transmission line access road. The second pot drop is located just north of the 161 kV H-pole transmission line centerline. The third ceramic scatter, isolated sherds, and the quartz scatter are located to the south of the transmission line access road. Direct impacts can be avoided to all of these features but this will require some careful project planning and impact avoidance measures. Indirect impacts, can be prevented through careful placement of protective fencing and markers during construction. Monitoring may also be advisable to prevent inadvertent off-road disturbance given the proximity to existing graded roads. Native American consultation is advised in developing impact mitigation measures at this site.

SITE 96-I1

This isolated chert flake is de facto not significant.

SITE 96-3

This arrangement of 50 granite and metavolcanic rocks with associated recent historic artifacts is a modern or recent "geoglyph." It is not significant because of its recent age and lack of association with important cultural patterns. No additional treatment is recommended.

IMP-7340

This site is composed of seven pieces of chert debitage located just south of the disturbed 161 kV H-pole transmission line right-of-way. The limited variability of materials and lack of diagnostics lead to the conclusion that this site is not significant. No additional treatment is recommended.

IV. REFERENCES

Hector, Susan M., William R. Manley, James D. Newland, and Stephan R. Van Wormer

1991 *The Archaeology of Obregon: Mining Activities in American Girl Canyon.* Prepared by Regional Environmental Consultants (RECON) for American Girl Mining Joint Venture, Winterhaven, California.

Schaefer, Jerry

1993 Historic Native American Pottery from the Mining Town of Hedges/Tumco, California. In *Hedges/Tumco, Historic Mining Traditions of Southeastern California,* by Michael S. Burney, Stephen R. Van Wormer, et al., pp. B.1-11. Prepared by Burney and Associates for P.M. De Dycker and Associates, Inc., Colorado and the USDI, Bureau of Land Management.

Schaefer, Jerry and Carol Schultze

1996 *Cultural Resources of Indian Pass: an Inventory and Evaluation for the Imperial Project, Imperial County, California.* Prepared by ASM Affiliates for Chemgold, Inc.

APPENDIX K - VISUAL CONTRAST RATING SHEETS

(September 1985)

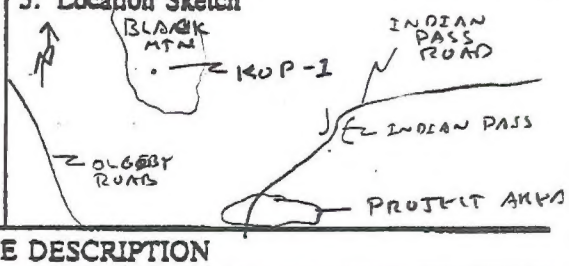
UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

VISUAL CONTRAST RATING WORKSHEET

Date: 8-17-95
District: CALIFORNIA DESERT
Resource Area: EL CENTRO
Activity (program): 3809

SECTION A. PROJECT INFORMATION

1. Project Name: IMPERIAL PROJECT
2. Key Observation Point: KOP-1
3. VRM Class: II
4. Location
   Township: 13 S
   Range: 20 E
   Section: UNSURVEYED
5. Location Sketch



SECTION B. CHARACTERISTIC LANDSCAPE DESCRIPTION

	1. LAND/WATER	2. VEGETATION	3. STRUCTURES
FORM	NEAR: STEEP, SMOOTH, SIMPLE MIDDLE: FLAT, SMOOTH, SIMPLE	NEAR: UNIFORM MIDDLE: LINEAR	-
LINE	NEAR: GGUMUTHE, SOFT MIDDLE: FLOWING, WEAK	NEAR: DIFFUSE, WEAK MIDDLE HORIZONTAL, BOLD	-
COLOR	NEAR: BLACK BROWN MIDDLE: TAN, GRAY, BROWN	NEAR: BROWN, TAN MIDDLE: GREEN, TAN	-
TEXTURE	NEAR: GRANULAR, PATCHY MIDDLE: STRIPED, DIAGONAL	NEAR: SPARCE, MEDIUM, EVEN, RANDOM MIDDLE: STRIPED, CONTRASTY	-

SECTION C. PROPOSED ACTIVITY DESCRIPTION

	1. LAND/WATER	2. VEGETATION	3. STRUCTURES
FORM	SMOOTH, ROUNDED, RHOMBOID MINOR CONICAL	SIMPLE, IRREGULAR	-
LINE	SOFT UNDULATING; DISCONTINUOUS MINOR ANGULAR	SINUOUS	-
COLOR	TAN, BROWN	TAN	-
TEXTURE	MEDIUM. PATCHY	SPARSE ROUGH	-

SECTION D. CONTRAST RATING ☐ SHORT TERM ☒ LONG TERM

1. DEGREE OF CONTRAST

	FEATURES											
	LAND/WATER BODY (1)				VEGETATION (2)				STRUCTURES (3)			
	Strong	Moderate	Weak	None	Strong	Moderate	Weak	None	Strong	Moderate	Weak	None
Form		✓					✓					–
Line		✓						✓				–
Color			✓					✓				–
Texture		✓					✓					–

TERMINUS

2. Does project design meet visual resource management objectives? ☐ Yes ☒ No (Explain on reverse side)

3. Additional mitigating measures recommended ☐ Yes ☒ No (Explain on reverse side)

Evaluator's Names: RICHARD F. DELUNA
Date: 8/17/95

(September 1985)

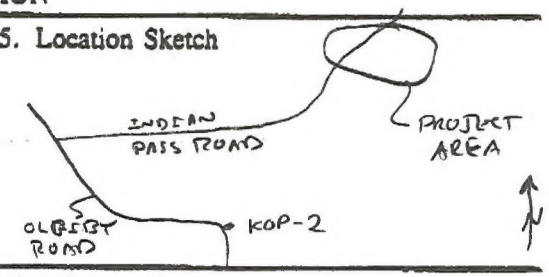
UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

VISUAL CONTRAST RATING WORKSHEET

Date: 8-17-95
District: CALIFORNIA DESERT
Resource Area: EL CENTRO
Activity (program): 3809

SECTION A. PROJECT INFORMATION

1. Project Name: IMPERIAL PROJECT
2. Key Observation Point: KOP-2
3. VRM Class: II
4. Location
   Township: 14S
   Range: 20E
   Section: UNSURVEYED
5. Location Sketch



SECTION B. CHARACTERISTIC LANDSCAPE DESCRIPTION

	1. LAND/[redacted]	2. VEGETATION	3. STRUCTURES
FORM	FAR: RHOMBOID MIDDLE: FLAT	FAR: NON DIRECTIONAL, MIDDLE: NON DIRECTIONAL,	—
LINE	FAR: ANGULAR/JAGGED & SMOOTH MIDDLE: WEAK, UNDULATING	FAR: WEAK, SOFT MIDDLE: WEAK, SOFT	—
COLOR	FAR: BROWN, TAN MIDDLE: TAN GRAY	FAR: TAN MIDDLE: GREEN TAN	—
TEXTURE	FAR: SMOOTH & ROUGH MIDDLE: SMOOTH	FAR: MEDIUM (D), FINE (L) E/R MIDDLE: MEDIUM (D) MEDIUM (L) U/R	—

SECTION C. PROPOSED ACTIVITY DESCRIPTION

	1. LAND/[redacted]	2. VEGETATION	3. STRUCTURES
FORM	SMOOTH, ROUNDED, RHOMBOID MINOR CONCAL	SIMPLE, IRREGULAR	—
LINE	SOFT, UNDULATING, DISCONTINUOUS MINOR ANGULAR	SINUOUS	—
COLOR	TAN, BROWN.	TAN	—
TEXTURE	MEDIUM PATCHY	SPARSE ROUGH	—

SECTION D. CONTRAST RATING ☐ SHORT TERM ☒ LONG TERM

1. DEGREE OF CONTRAST	FEATURES: LAND/WATER BODY (1)				VEGETATION (2)				STRUCTURES (3)			
	Strong	Moderate	Weak	None	Strong	Moderate	Weak	None	Strong	Moderate	Weak	None
Form		✓					✓					—
Line		✓						✓				—
Color			✓					✓				—
Texture		✓					✓					—

2. Does project design meet visual resource management objectives? ☐ Yes ☒ No (Explain on reverse side)

3. Additional mitigating measures recommended ☐ Yes ☒ No (Explain on reverse side)

Evaluator's Names: RICHARD F. DELONG
Date: 8-17-95

(September 1985)

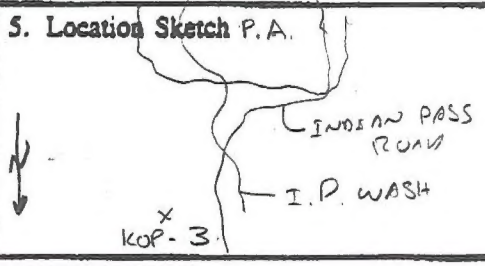
UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

VISUAL CONTRAST RATING WORKSHEET

Date: 8-17-95
District: CALIFORNIA DESERT
Resource Area: EL CENTRO
Activity (program): 3809

SECTION A. PROJECT INFORMATION

1. Project Name: IMPERIAL PROJECT
2. Key Observation Point: KOP-3
3. VRM Class: II
4. Location
   Township: 13S
   Range: 21E
   Section: UNSURVEYED
5. Location Sketch P.A.



SECTION B. CHARACTERISTIC LANDSCAPE DESCRIPTION

	1. LAND/~~WATER~~	2. VEGETATION	3. STRUCTURES
FORM	FLAT, SMOOTH / MINOR ROLLING	LINEAR, IRREGULAR	—
LINE	UNDULATING, IRREGULAR	SINUOUS	—
COLOR	TAN, BROWN BLACK	GREEN, TAN	—
TEXTURE	GRANULAR, SPARSE, PATCHY	STRAGG / SPARSE ROUGH	—

SECTION C. PROPOSED ACTIVITY DESCRIPTION

	1. LAND/~~WATER~~	2. VEGETATION	3. STRUCTURES
FORM	SMOOTH, ROUNDED, RHOMBOID MINOR CONTRAST	SIMPLE IRREGULAR	—
LINE	SOFT, UNDULATING; DISCONTINUOUS MINOR ANGULAR	SINUOUS	—
COLOR	TAN, BROWN	TAN	—
TEXTURE	MEDIUM, PATCHY	SPARSE ROUGH	—

SECTION D. CONTRAST RATING ☐ SHORT TERM ☒ LONG TERM

1. DEGREE OF CONTRAST

ELEMENTS	FEATURES: LAND/WATER BODY (1)				VEGETATION (2)				STRUCTURES (3)			
	Strong	Moderate	Weak	None	Strong	Moderate	Weak	None	Strong	Moderate	Weak	None
Form		✓					✓					—
Line		✓					·	✓				—
Color			✓					✓				—
Texture		✓					✓					—

2. Does project design meet visual resource management objectives? ☐ Yes ☒ No (Explain on reverse side)

3. Additional mitigating measures recommended ☐ Yes ☒ No (Explain on reverse side)

Evaluator's Names: RICHARD F DELONG
Date: 8-17-95

This page intentionally left blank
for reproduction purposes.

APPENDIX L - CHEMGOLD IMPERIAL PROJECT AIR QUALITY ANALYSIS

CHEMGOLD IMPERIAL PROJECT
IMPERIAL COUNTY, CALIFORNIA

AIR QUALITY ANALYSIS

August 1996

Prepared For

Chemgold, Inc.
Post Office Box 758
Winterhaven, California 92883

Prepared By:

Environmental Management Associates, Inc.

EMA Corporate Headquarters
1698 Greenbriar Lane, Suite 210
Brea, California 92821-5919
(714) 529-3695 • Fax (714) 529-8543

EMA Regional Office
100 West Grove Street, Suite 100
Reno, Nevada 89509-4026
(702) 828-3939 • Fax (702) 828-3940

CHEMGOLD IMPERIAL PROJECT
IMPERIAL COUNTY, CALIFORNIA

AIR QUALITY ANALYSIS

TABLE OF CONTENTS

Page

TABLE OF CONTENTS i

LIST OF FIGURES ii

LIST OF TABLES ii

LIST OF APPENDICES ii

1. INTRODUCTION AND PROJECT DESCRIPTION 1
   - 1.1. Project Location 1
   - 1.2. Project Description 4
   - 1.3. Regulatory Framework 5

2. AIR QUALITY ASSESSMENT 10
   - 2.1. Air Pollutant Emission Sources and Emissions 10
   - 2.2. Air Quality Assessment 14
     - 2.2.1. Title V of the CAAA 14
     - 2.2.2. Compliance with Ambient Air Quality Standards 16
       - 2.2.2.1. Particulate Matter Less than 10 Microns (PM_{10}) 16
         - 2.2.2.1.1. Introduction 16
         - 2.2.2.1.2. Modeled Emissions Units and Assumptions 16
         - 2.2.2.1.3. Receptors 17
         - 2.2.2.1.4. Meteorological Data 18
         - 2.2.2.1.5. Results of PM_{10} Modeling 19
       - 2.2.2.2. Criteria Air Pollutants Other Than PM_{10} 20

3. REFERENCES 21

LIST OF FIGURES

Page

Figure 1: Imperial Project General Location Map 2
Figure 2: Imperial Project Vicinity Map 3
Figure 3: Imperial Project Facility Locations 6
Figure 4: Imperial Project Mine and Process Area Facilities 7

LIST OF TABLES

Page

Table 1: Estimated Disturbed and Undisturbed Acres for the Imperial Project 8
Table 2: Federal and State Ambient Air Quality Standards for Criteria Pollutants 9
Table 3: List of Potential Emission Sources and Type for the Proposed Action 11
Table 4: List of Project "Non-Road" Engines and Applicability Criteria 14

LIST OF APPENDICES

APPENDIX A- MASTER LIST OF SOURCES

APPENDIX B - PROJECT INFORMATION - MAXIMUM 24-HOUR OPERATIONS

APPENDIX C - PROJECT INFORMATION - ANNUAL OPERATIONS

APPENDIX D - EMISSION CALCULATIONS - MAXIMUM 24-HOUR OPERATIONS

APPENDIX E - EMISSION CALCULATIONS - ANNUAL OPERATIONS

APPENDIX F - SUMMARY REPORT OF CALCULATIONS OF EMISSIONS FROM LIQUID ORGANIC TANKS FROM U.S. EPA TANKS PROGRAM (VERSION 2.0)

APPENDIX G - TOTAL CALCULATED REGULATED (CRITERIA) AIR POLLUTANT EMISSIONS

APPENDIX H - TOTAL FACILITY POTENTIAL TO EMIT FOR TITLE V APPLICABLE REGULATED (CRITERIA) AIR POLLUTANTS

APPENDIX I - TOTAL FACILITY POTENTIAL TO EMIT FOR TITLE V APPLICABLE HAZARDOUS AIR POLLUTANTS (HAPs)

APPENDIX J - MODELING SOURCE PARAMETER TABLES

APPENDIX K - PLATES

APPENDIX L - U.S. EPA INDUSTRIAL SOURCE COMPLEX - SHORT TERM (ISCST3) DISPERSION MODELING RESULTS

APPENDIX L-1 - Maximum 24-Hour PM_{10} Concentrations - 1000 and 250 Meter Screening Grids With Discrete (Boundary) Receptors

APPENDIX L-2 - Maximum 24-Hour PM_{10} Concentrations - 100 Meter Receptor Grid

APPENDIX L-3 - Average Annual PM_{10} Concentrations - 1000 and 250 Meter Screening Grid & Discrete (Boundary) Receptors

APPENDIX L-4 - Average Annual PM_{10} Concentrations - 100 Meter Receptor Grid

CHEMGOLD IMPERIAL PROJECT
IMPERIAL COUNTY, CALIFORNIA

AIR QUALITY ANALYSIS

1. INTRODUCTION AND PROJECT DESCRIPTION

Chemgold, Inc. (Chemgold) has proposed the development of the Imperial Project (Project), an open-pit, heap leach, precious metal mine and processing facility located in eastern Imperial County, California which would utilize conventional heap leach mining methods to extract gold and silver from the mined ore. This document provides an estimate of the air pollutant emissions from the Project, and an analysis of the expected impacts of the Project on air quality in the area.

1.1. Project Location

The Project is located in eastern Imperial County, California, approximately 45 miles northeast of El Centro, California and 20 miles northwest of Yuma, Arizona (Figure 1). The Project is located within Sections 28, 29, 30, 31, 32 and 33, Township 13 South, Range 21 East, and Sections 4, 5, 6, 7, and 8, Township 14 South, Range 21 East, San Bernardino Baseline & Meridian (SBB&M), on public lands administered by the Bureau of Land Management (BLM). The boundary of the Project mine and process area is presented in Figure 2.

Access to the Project area is from Ogilby Road via Interstate 8 from the south, or from California Highway 78 to the north. The Project mine and process area overlaps Imperial County-maintained Indian Pass Road, and is located approximately five (5) miles northeast of the Indian Pass Road/Ogilby Road intersection.

The Project mine and process area boundary encompasses approximately 1,612 acres on a broad, south and west facing, alluvial plain south of Indian Pass in the Chocolate Mountains, between the Cargo Muchacho Mountains, approximately four (4) miles south, and Peter Kane Mountain, approximately six (6) miles north. The elevation over the Project mine and process area ranges from about 760 feet to 925 feet. The Project lies near the center of the mining district formed by the active Picacho, Mesquite, and American Girl heap leach gold mines, each located approximately 10 miles from the Project mine and process area (see Figure 2).

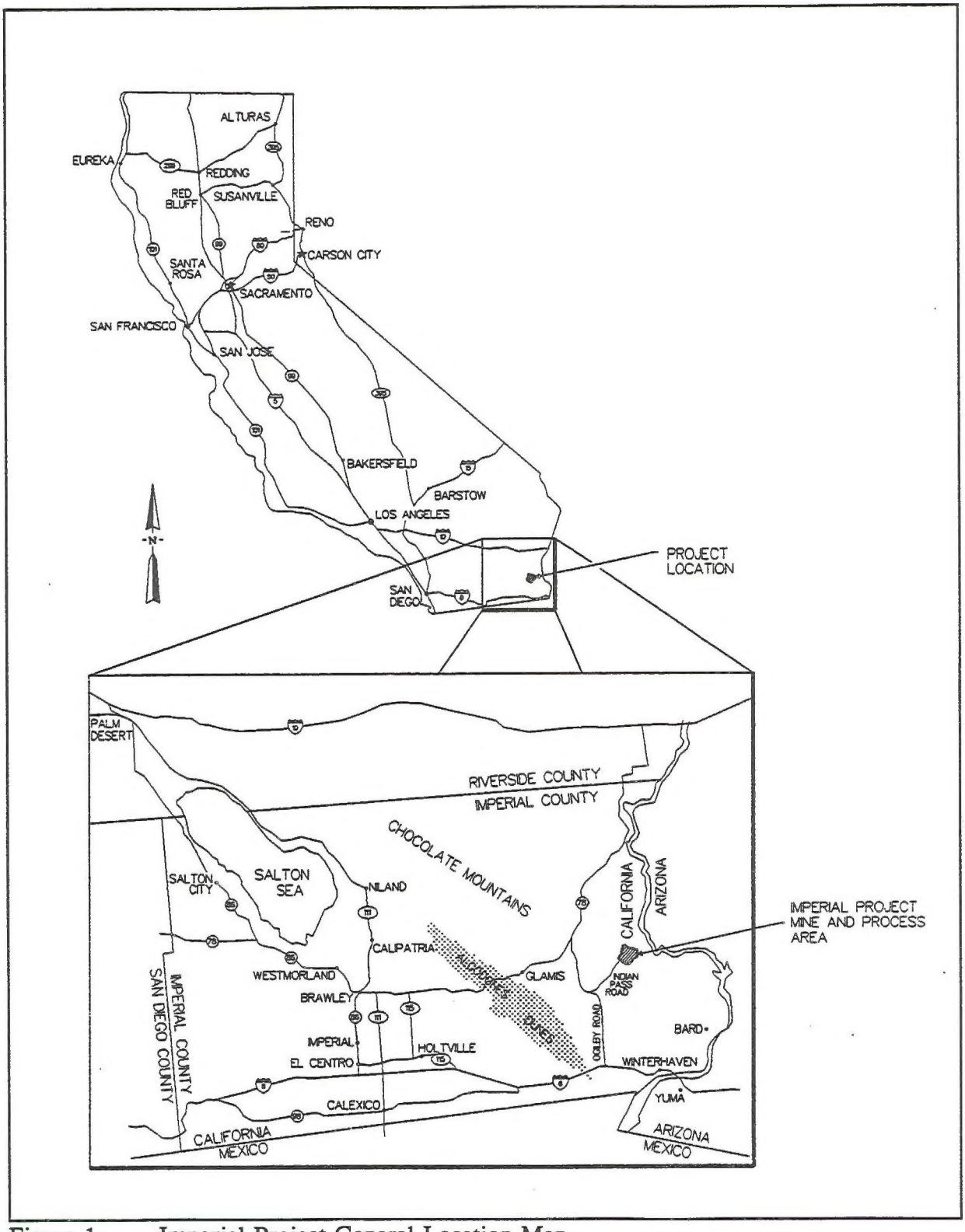


Figure 1: Imperial Project General Location Map

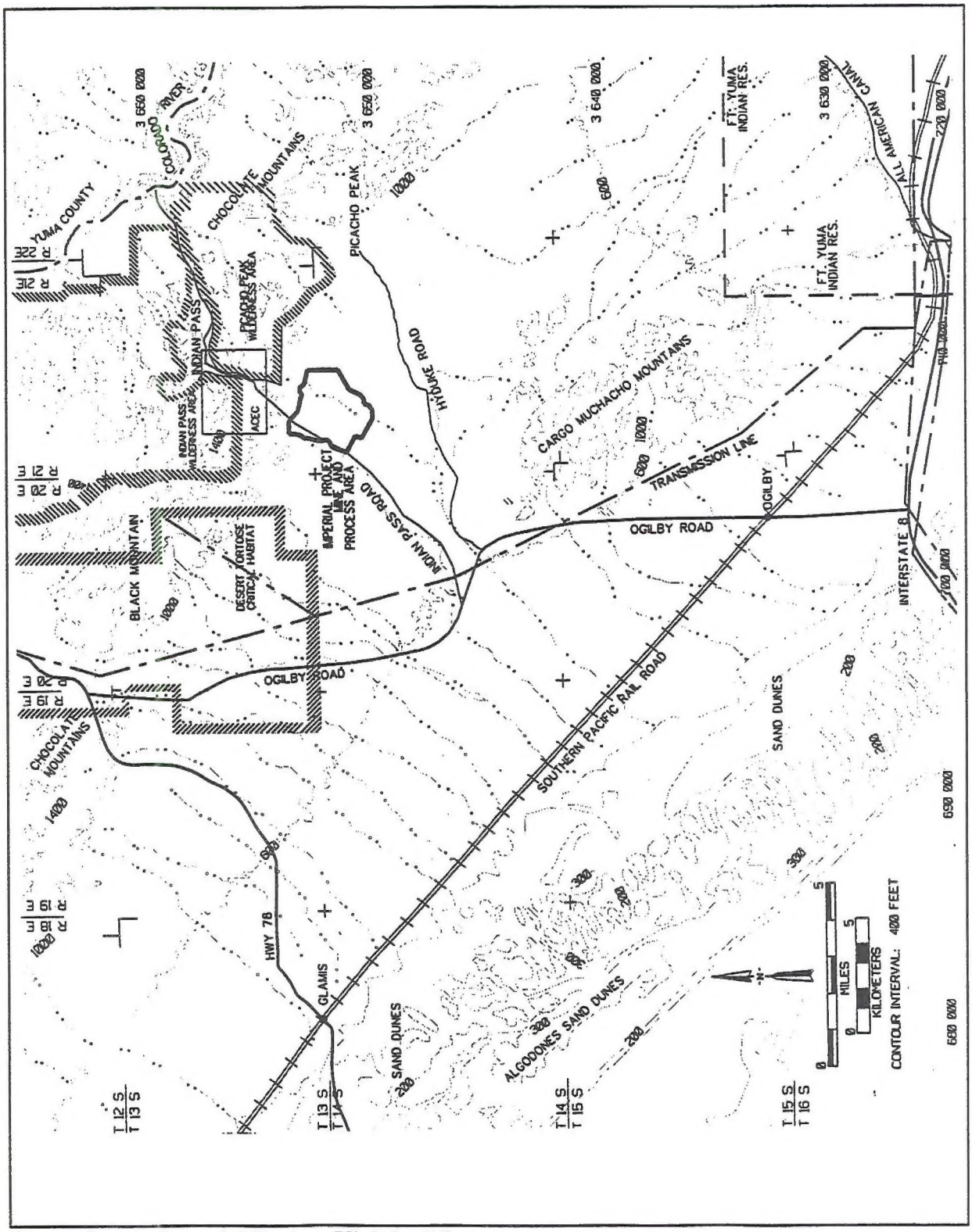


Figure 2: Imperial Project Vicinity Map

1.2. Project Description

The Imperial Project (Project) is a proposal to develop an open-pit precious metal mining operation utilizing heap leach processes. The Project would include: mining gold and silver ore and waste rock at a maximum average operating rate of 130,000 tons per day for up to twenty (20) years; constructing facilities to administer the operation; maintenance of all mining and related equipment; processing the ore and stockpiling the waste rock; developing and producing ground water for use in processing operations; performing continuing exploration activities; implementing environmental impact reduction measures; and implementing site reclamation measures. The proposed Project has been designed to meet the anticipated permit requirements of the various federal, state and local agencies which regulate mining in the area.

The proposed Project would consist of the following components:

- Within the Project mine and process area:
  - Three (3) open pits, identified as the West Pit, East Pit and Singer Pit, and one (1) Mineralized Potential Area, co-joining the three (3) separate pits;
  - Four (4) waste rock stockpiles;
  - Four (4) soil stockpile sites.
  - One (1) administration office and maintenance facility area;
  - Ore processing facilities;
  - One (1) precious metal recovery plant and other related facilities;
  - A system of roads internal to the Project site which would connect the various facility components; and
  - One (1) electrical power substation.
- Within the Project ancillary area:
  - An electrical metering station and a 4.5-mile section of new 92/7.5 kV transmission line;
  - One (1) ground water well field, consisting of up to four (4) production wells, designed to produce ground water at a peak rate of approximately 1,000 gallons

per minute (gpm) and peak yield of approximately 1,200 acre feet per year (afy), and an associated water pipeline; and

- Relocated portions of Indian Pass Road, including realignment of the intersection of Indian Pass Road and Ogilby Road and the relocation of an approximately 6,000-foot portion of Indian Pass Road, which would be moved approximately 1,000 feet to the west of its current location to provide continuing public access to areas northeast of the Project.

A 16-mile long portion of an existing 34.5 kV utility transmission line would also be "overbuilt" with a new 92 kV transmission line using existing access roads and rights-of-way.

Up to 150 million tons of ore would be leached under the Proposed Action. At a waste:ore ratio of up to 3:1, up to 450 million tons of waste rock would be deposited in the waste rock stockpiles or the mined-out portions of the open pits. Mining activities, performed 24 hours per day and seven (7) days per week, would commence in early 1997, and would terminate by approximately the year 2016.

Figure 3 shows the boundaries of the Project mine and process area and a shaded area indicating the Project ancillary area. The locations of the major facilities proposed within the Project mine and process area are presented in Figure 4. The proposed Project would create a maximum of approximately 1,400 acres of new surface disturbance, all within the Project area. An itemized list of surface disturbance for each of the major Project facilities, together with the undisturbed acreage within the Project mine and process area and Project ancillary area, is presented in Table 1.

1.3. Regulatory Framework

Ambient air quality and the emission of air pollutants are regulated under both federal and California laws and regulations. In addition, there are local requirements and standards which provide regulation of both air quality and the emission of air pollutants in the Project area.

The federal Clean Air Act (CAA), and the subsequent Clean Air Act Amendments (CAAA), required the U.S. Environmental Protection Agency (EPA) to identify national ambient air quality standards (NAAQS) to protect public health and welfare. NAAQS have been established for six (6) pollutants, known as "criteria" pollutants because the standards satisfy "criteria" specified in the CAA. A list of the criteria pollutants regulated by the CAA, and the standards set by the EPA for each, are listed in Table 2.

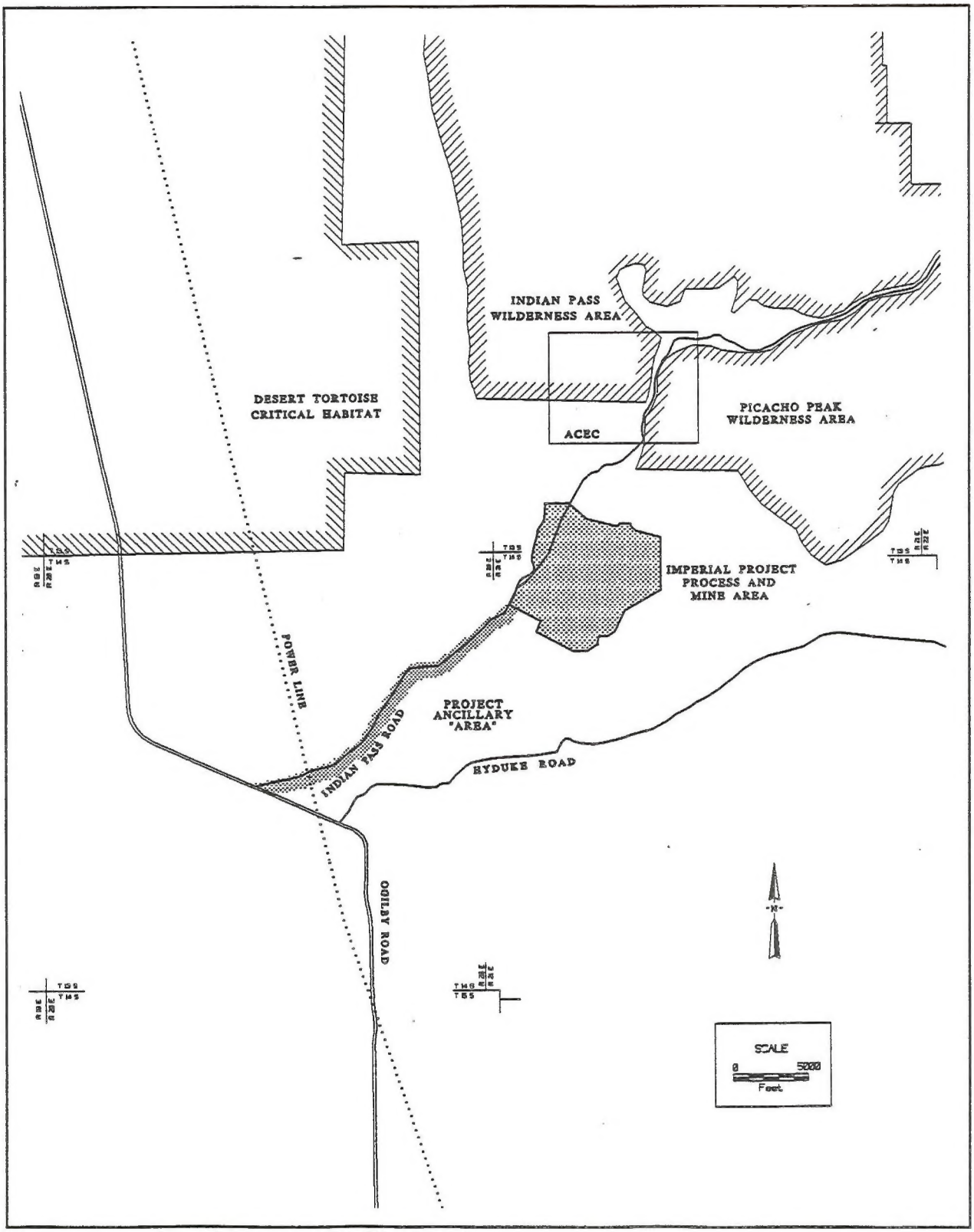


Figure 3: Imperial Project Facility Locations

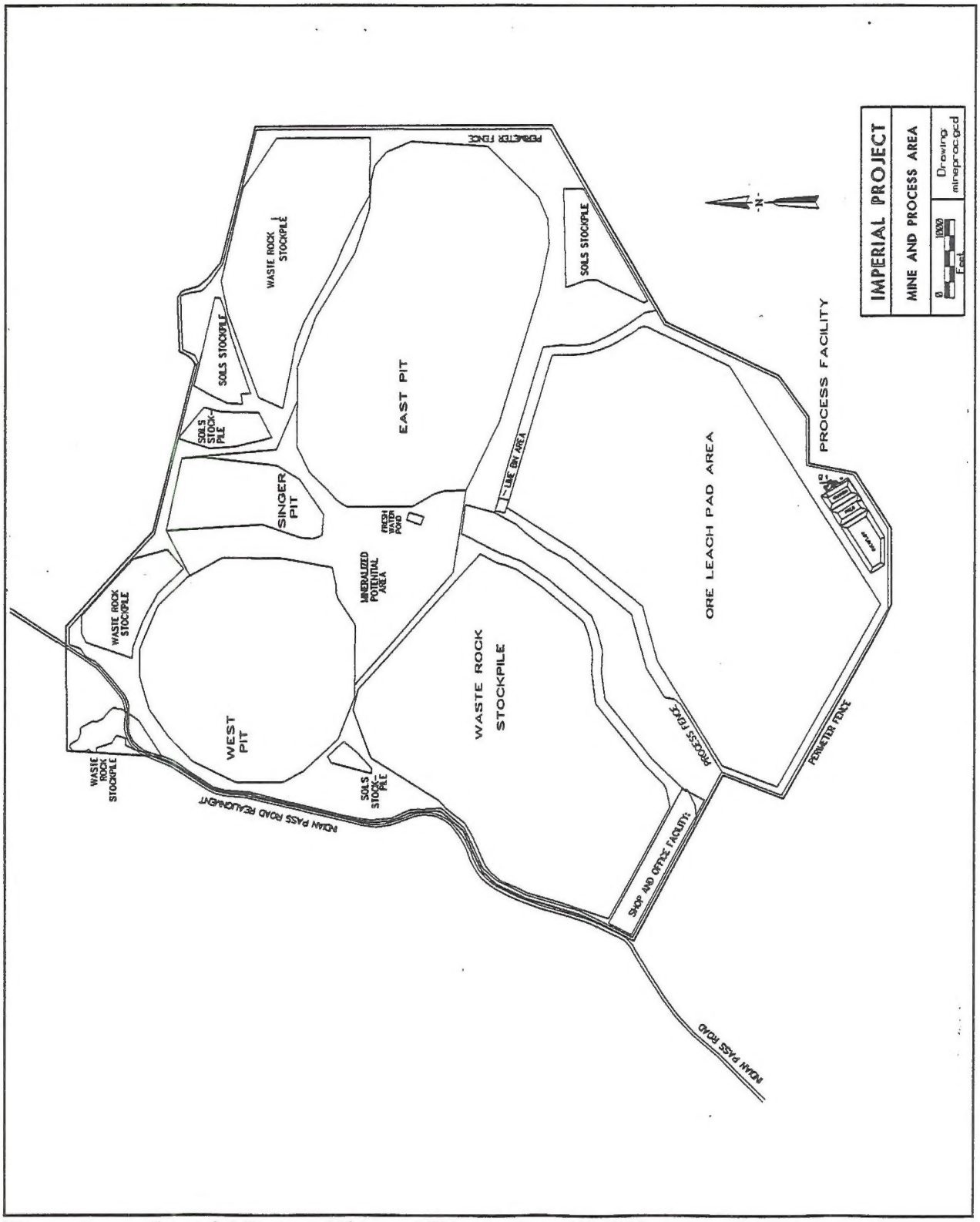


Figure 4: Imperial Project Mine and Process Area Facilities

Table 1: Estimated Disturbed and Undisturbed Acres for the Imperial Project

MINE FACILITY COMPONENT		DISTURBED ACRES	UNDISTURBED ACRES
Mine and Process Area			
Pits	West Pit	124	
	East Pit	227	
	Singer Pit	34	
	Mineral Potential Area	68	
	Subtotal:	**453**	
Process Facilities	Pad	329	
	Process Facility Area	21	
	Lime Bin Area and Fresh Water Pond	1	
	Subtotal:	**351**	
Waste Rock Stockpiles	East Waste Rock Stockpile	73	
	West Waste Rock Stockpiles (two adjacent stockpiles)	28	
	South Waste Rock Stockpile	224	
	Subtotal:	**325**	
Soil Stockpiles	West Soil Stockpile	3	
	North Soil Stockpiles (two adjacent stockpiles)	21	
	South Soil Stockpile	17	
	Subtotal:	**41**	
Support Facilities	Office/Maintenance/Parking/Power	14	
	Haul and Maintenance Roads	164	
	Drainage Diversions	16	
	Subtotal:	**194**	
	Mine and Process Area Subtotals:	1,364	248
	Total Mine and Process Area Acreage:	**1,612**	
Ancillary Area			
County Road Realignment		7	
Powerline, Water Wells and Pipeline Route		29	
	Ancillary Area Subtotals:	36	-
	Total Ancillary Area Acreage:	**36**	
TOTAL PROJECT AREA DISTURBED AND UNDISTURBED ACREAGE:		**1,400**	**248**
	TOTAL PROJECT AREA ACREAGE:	**1,648**	

Table 2: Federal and State Ambient Air Quality Standards for Criteria Pollutants

Criteria Pollutant	Averaging Period	California Standards	Federal Standards	
		Concentration[a]	Primary[a]	Secondary[a]
Ozone (O_3)	1-Hour	90 ppbv (180 $\mu g/m^3$)	120 ppbv (235 $\mu g/m^3$)	Same as Primary Standards
Carbon Monoxide (CO)	8-Hour	9 ppmv (10 mg/m^3)	9 ppmv (10 mg/m^3)	-
	1-Hour	20 ppmv (23 mg/m^3)	35 ppmv (40 mg/m^3)	
Oxides of Nitrogen (NO_x) as Nitrogen Dioxide (NO_2)	Annual	-	53 ppbv (100 $\mu p/m^3$)	Same as Primary Standards
	1-Hour	250 ppbv (470 $\mu g/m^3$)	-	
Sulfur Dioxide (SO_2)	Annual	-	30 ppbv (80 $\mu g/m^3$)	-
	24-Hour	40 ppbv (105 $\mu g/m^3$)	140 ppbv (365 $\mu g/m^3$)	-
	3-Hour	-	-	500 ppbv (1,300 $\mu g/m^3$)
	1-Hour	250 ppbv (655 $\mu g/m^3$)	-	-
Particulate Matter ≤ 10 Microns in Diameter (PM_{10})	Annual Geometric Mean	30 $\mu g/m^3$	-	-
	24-Hour	50 $\mu g/m^3$	150$\mu g/m^3$	Same as Primary Standards
	Annual Arithmetic Mean	-	50 $\mu g/m^3$	
Sulfates (SO_4)	24-Hour	25 $\mu g/m^3$	-	-
Lead (Pb)	30-Day	1.5 $\mu g/m^3$	-	-
	Calendar Quarter	-	1.5 $\mu g/m^3$	Same as Primary Standards
Hydrogen Sulfide (H_2S)	1-Hour	30 ppbv (42 $\mu g/m^3$)	-	-

[a] Equivalent units given in parentheses are based upon a reference temperature of 25°C and a reference pressure of 760 mm mercury. Measurements of air quality are corrected to a reference temperature of 25°C and a reference pressure of 760 mm mercury (1,013.2 millibar); ppmv and ppbv in this table refer to ppm and ppb by volume, respectively, or micro-moles of pollutant per mole of gas. $\mu g/m^3$ ≡ micrograms per cubic meter (CARB, 1994).

The California Air Resources Board (CARB), which is part of the California Environmental Protection Agency (Cal-EPA), is the California state agency with responsibility for establishing California state ambient air quality standards (CAAQS) under the California Clean Air Act. The CAAQS are generally more stringent than the NAAQS. A list of the California "criteria" air pollutants, and the CAAQS adopted for each, are also included in Table 2.

2. AIR QUALITY ASSESSMENT

2.1. Air Pollutant Emission Sources and Emissions

The proposed Project consists of many activities and operations, each of which may have the potential to emit air pollutants. A comprehensive list of each of the identified individual potential sources of Project air pollutant emissions ("emission units"), organized into "emission groups" of similar activities (such as mining, heap leaching, etc.), are presented in Table 3. Each of the air pollutants potentially emitted from each of these emission units is presented in Appendix A.

In addition to being organized into emission groups, these emission units can also be characterized by the "type" of emission unit. Four (4) different types of emission units are applicable to the Project: stationary "point" sources (e.g., the emergency diesel-fuel electric generator); "fugitive" sources (i.e., those which do not emit pollutants from single points, but from diffuse areas (e.g., dust generated by vehicles moving on unpaved roads)); mobile combustion sources (e.g., the "tailpipe" emissions from haul trucks, dozers, etc.); and "other" sources (e.g., vapor emissions from the storage of fuel in storage tanks). Table 3 also provides the emission "type" for each of the Project emission sources.

Estimates of the annual emissions of each applicable criteria air pollutant from each emission unit were calculated using generally available emission estimating techniques and operational parameters for each of the emission units as provided by Chemgold. Appendix B and Appendix C present the Project information provided by Chemgold as used in the emission estimate calculations for the maximum 24-hour and annual operations respectively. Appendix D and Appendix E present the actual emission calculations for the maximum 24-hour and annual operations, respectively. As indicated in Appendix D and Appendix E, these calculations assume the implementation of the "emission control" techniques proposed to be implemented as a part of the proposed Project to reduce the emissions (such as the watering of roads). Appendix F presents the summary report of the calculations from the U.S. EPA Tanks Program, which was used to calculate the emissions of volatile organic compounds from the fuel storage tanks as presented in Appendix D and Appendix E. Appendix G provides a summary of the maximum estimated daily (in pounds per day) and annual (in tons per year) regulated (criteria) air pollutant emissions expected from the Project.

Table 3: List of Potential Emission Sources and Type for the Proposed Action

Emission Unit	Emission Unit Description	Emission "Source" Type			
		Stationary Point	Fugitive	Mobile	Other
Emission Unit Group 1: Mining Activity					
1.001	Drilling - Waste Rock		X		
1.002	Drilling - Ore		X		
1.003	Blasting - Waste Rock		X		
1.004	Blasting - Ore		X		
1.005	Waste Rock Loading		X		
1.006	Ore Loading		X		
1.007	Waste Rock Dumping		X		
1.008	Ore Dumping		X		
1.009	Waste Rock Dozing		X		
1.010	Waste Rock Hauling		X		
1.011	Ore Hauling		X		
1.012	Ammonium Nitrate Prill Silo Loading	X			
1.013	Ammonium Nitrate Prill Silo Unloading	X			
1.014	Wind Erosion (Waste Rock Stockpile)		X		
1.015	Wind Erosion (Soil Stockpiles)		X		
1.016	Haul Truck (Combustion)			X	
1.017	Mine Dozer (Combustion)			X	
1.018	Drill Rig (Combustion)			X	
1.019	Loader (Combustion)			X	
1.020	Clean-Up Loader (Combustion)			X	
Emission Unit Group 2: Heap Leaching Activity					
2.001	Portable R-O-M Lime Silo Loading	X			
2.002	Portable R-O-M Lime Hopper Loading	X			
2.003	Lime Application to Ore		X		
2.004	Ore Ripping/Spreading/Dozing		X		
2.005	Grader (Combustion)			X	
2.006	Heap Leach Dozer (Combustion)			X	
2.007	Cyanide Application and Leaching		X		
2.008	Pregnant Solution Pond		X		
2.009	Barren Solution Pond		X		
2.010	Wind Erosion (Heap Leach Pad) - Non-Leach		X		
2.011	Wind Erosion (Heap Leach Pad) - Leach		X		

Emission Unit	Emission Unit Description	Emission "Source" Type			
		Stationary Point	Fugitive	Mobile	Other
Emission Unit Group 3: Process Plant					
3.001	Carbon Adsorption Tank 1		X		
3.002	Carbon Adsorption Tank 2		X		
3.003	Carbon Adsorption Tank 3		X		
3.004	Carbon Adsorption Tank 4		X		
3.005	Carbon Adsorption Tank 5		X		
3.006	Acid Wash Tank		X		X
3.007	Cyanide Make-up Tank		X		
3.008	Strip Tank		X		
3.009	Electrowinning Cell		X		X
Emission Unit Group 4: Refining					
4.001	Mercury Retort Furnace (Electric)	X			
Emission Unit Group 5: Laboratory					
5.001	Jaw Crusher	X			
5.002	Pulverizer	X			
5.003	Fume Hood	X			
5.004	Waste Acid Tank		X		
Emission Unit Group 6: Shop Area					
6.001	Main Diesel Tank 1				X
6.002	Street Diesel Tank				X
6.003	Unleaded Gasoline Tank				X
6.004	Coolant Tank				X
Emission Unit Group 7: Mine & Process Area Support Activities					
7.001	Water Truck (Combustion)			X	
7.002	Water Truck Traffic		X		
7.003	Backup Diesel-Fueled Generator	X			
Emission Unit Group 8: Other Mobile Emission Units					
8.001	On-Site Delivery Truck Traffic		X		
8.002	On-Site Light Vehicle Traffic		X		
8.003	Off-Site Delivery Truck Traffic		X		
8.004	Off-Site Light Vehicle Traffic		X		
8.005	On-Site Delivery Truck (Combustion)			X	
8.006	On-Site Light Vehicle (Combustion)			X	

Fugitive emission sources, especially emitters of fugitive particulate matter (TSP and PM_{10}), are the largest proportion of the emission units. Mining and heap leaching activities, such as blasting, loading, dumping and dozing, release fugitive particulate matter into the air through the physical movement of the ore or waste rock. Ore and waste rock hauling, and truck and vehicle traffic, all generate fugitive particulate matter emissions by traveling on unpaved roads. Finally, wind erosion of both the waste rock stockpiles and ore heap can generate fugitive particulate matter emissions.

Mobile sources, the next largest category of sources, are principally associated with the mining and heap leaching process. They consist exclusively of large diesel engines which power the haul trucks, dozers, graders, and water trucks. Because of the high percentages of use (many will operate nearly 24 hours per day), these mobile sources will produce substantial quantities of "tailpipe" combustion emissions, such as NO_x, SO_x, and CO.

Most of the mobile sources fall into the category of "non-road engines," generally defined under 40 CFR §89 as internal combustion engines which are in or propel a vehicle which is not a "road" vehicle, or are portable or transportable, but which do not remain in a fixed location for more than a year. These federal regulations require that "non-road" engines must be manufactured to meet specific emission standards for criteria pollutants, based on the size (kW or hp rating) of the engine and date of manufacture, according to a specific timetable commencing on January 1, 1996. Table 4 lists the identified Project "non-road" engines, the size (hp rating) of each, whether the engine will be purchased (in 1997) "new" or "used," and whether the engine will be subject to these new federal emission limitations.

Table 4: List of Project "Non-Road" Engines and Applicability Criteria

Engine (number)	Engine Rating	Year of Manufacture	Applicability of 40 CFR 89
Haul Trucks (8)	2,500 hp	1997	No
Dozers (2)	375 hp	1997	Yes
Drill Rig (1)	550 hp	1997	Yes
Loader (1)	1,250 hp	1997	No
Clean-up Loader (1)	690 hp	<1996	No
Water Trucks (2)	1,050 hp	<1996	No
Grader (1)	275 hp	1997	Yes
Back-Up Generator (1)	750 hp	1997	Yes

Based on the Project engine size ratings and their assumed date of manufacture (based on the purchase date), less than half of the Project "non-road" engines would be required to be manufactured to met the new federal emission standards.

Although the Project has a number of stationary point sources, these sources are individually and collectively minor sources of criteria air pollutant emissions. About one-half of the stationary point sources are combustion sources, which as a class emit substantially more gaseous combustion pollutants (NO_x, SO_x, and CO) than particulate matter.

Finally, the "other" category of criteria pollutant emission sources consist exclusively of the diesel, gasoline and other volatile organic compound storage and dispensing tanks. However, the total quantities of these materials emitted by the Project to the atmosphere are small.

2.2. Air Quality Assessment

2.2.1. Title V of the CAAA

The CAAA included Title V, which established a very detailed and extensive operating permit system for "major sources" of regulated air pollutants. The Imperial County Air Pollution Control District (ICAPCD) has adopted Rule 900 to implement Title V within the District, and EPA's delegation of authority to implement Title V through Rule 900 became effective on June 2, 1995. Rule 900 is applicable only to "major" sources of air pollutants, which are defined as "a stationary source which has the potential to emit a regulated air pollutant or a hazardous air pollutant (HAP) in quantities equal to or exceeding the lesser of any of the following thresholds:"

"100 tons per year (tpy) of any regulated air pollutant;"

"10 tpy of one HAP or 25 tpy of two or more HAP's; or"

"Any lesser quantity threshold promulgated by the U.S. EPA."

At present, no lower quantity threshold has been set by the U.S. EPA.

To determine the applicability of Title V (Rule 900) to the Project, the summary of the inventory of the annual air pollutant emissions of all emission units provided for the Proposed Action in Appendix G was recalculated in Appendix H to present the annual potential to emit for only the emission units applicable under Title V (Rule 900). Since Title V (Rule 900) is basically applicable as to criteria (regulated) air pollutants only to stationary point sources, as Appendix H indicates, few of the Project's emission units are included in the Title V applicability for criteria pollutants.

The largest applicable annual emission rate for a single criteria pollutant for the Proposed Action is 0.64 tons per year of volatile organic compounds/reactive organic gases (VOCs/ROGs); all of this is emitted from the fuel and other organic liquid storage and dispensing facilities.

HAPs are specifically listed hazardous air pollutants, some of which can be found in many of the natural earth materials which will be mined by the Project; in the fuels used and stored by the Project; and in the solution used to leach the precious metals from the ore. Current EPA and ICAPCD guidance provides that reasonably quantifiable HAP emissions from fugitive sources, as well as from stationary sources, must be counted to determine the applicability of Title V for HAPs. The potential metal HAPs component of the emitted Project particulates has been conservatively estimated in Appendix E by assuming that all of the HAPs contained in the fugitive particulate matter emitted by the Project are subject to Title V (Rule 900). Based upon analyses of ore and waste rock samples collected during exploration drilling (see Appendix C), and using the calculated total annual TSP emission estimates (see Appendix E), the total annual emission of particulate-based HAPs has been estimated. As indicated in Appendix I, the Project total potential to emit for all Title V applicable metal HAPs is less than 0.01 tons.

HAPs released as a result of the combustion of diesel fuel and gasoline in mobile engines are not subject to Title V (Rule 900). Because of its limited use, combustion HAPs from the diesel-fueled emergency generator total less than one (1) pound (0.0002 ton) per year. The HAPs released from the leaching solution (principally HCN), which are difficult and unreliable to estimate and may not be subject to Rule 900, are estimated at 9.5 tons, slightly less than the 10 ton-per-year Title V threshold for a single HAP. The total annual emission of all potentially applicable HAPs from the Project, including HCN, is approximately 9.9 tons, substantially below the 25 ton Title V threshold (see Appendix I).

As a result, the Project will not be subject to Title V of the CAAA (ICAPCD Rule 900).

2.2.2. Compliance with Ambient Air Quality Standards

2.2.2.1. Particulate Matter Less than 10 Microns (PM_{10})

The principal pollutant of concern from the Project is PM_{10}. Nearly all of the Project PM_{10} emissions are from fugitive and mobile sources, with emissions occurring throughout the 1,612-acre Project mine and process area. Computer-aided dispersion modeling for the Project PM_{10} emissions was conducted using the U.S. Environmental Protection Agency Industrial Source Complex - Short Term (ISCST3R) dispersion model utilizing the Trinity Consultants, Inc. Breeze

"graphical front end" (IBM-PC Version 3.00, Dated 96113). EMA used the EPA's regulatory default model options as outlined in Appendix A of the Guideline on Air Quality Models (Revised) (EPA, 1987). In addition, EMA used rural dispersion parameters and elevated terrain.

2.2.2.1.1. Introduction

Dispersion modeling is a technique for calculating estimated concentrations of pollutants that are the result of emissions from a given facility. Emissions may be from "point" sources (stacks or vents); "area" sources (regions with a distinct square footage and little or no vertical velocity, e.g. a lagoon or heap); "volume" sources (buildings or elevated conveyors); "line" sources (road emissions); and "openpit" sources (below grade operations such as open pit coal mining). In modeling a "line" source, the ISCST3 Model (ISC) utilizes a series of "area" or "volume" sources to estimate emissions. Non-reactive, "lighter-than-air" emissions from these sources are modeled based a gaussian distribution, which is a relatively good mathematical approximation of plume behavior (Schulze, 1991).

2.2.2.1.2. Modeled Emissions Units and Assumptions

Appendix J (Table 1 and Table 2) provides, for each of the modeled emission units (sources of PM_{10} emissions), all of the emission parameters used in the ambient air modeling conducted for the proposed Project. Table 1 lists the applicable modeling parameters for each of the proposed "point sources," while Table 2 provides all of the applicable modeling parameters for each of the "area sources" and "line sources." Emission rates for each of the individual emission units were calculated using the emission estimates presented in Appendix D and Appendix E. Based upon information provided by Chemgold, activities proposed to be conducted during Project Year 2, which is the first full year of full operation of all of the major Project components, were used to place the locations of the emission units. A diagram showing the locations of each of the emission units is provided as Plate 1, located in Appendix K.

In order to simplify the modeling runs, emissions which occur over the same area (i.e. multiple vehicles and/or operations over the same segment of haul road) were combined into one source, with a single emission rate. Emissions from the haul roads were modeled as "area" line sources, with emissions spread over the entire length of each road segment, using a weighted distribution based on the area of the road segments. In addition, emissions from those sources which occur within a pit (e.g. drilling, blasting,

loading, and initial hauling) were combined and modeled using the ISC "openpit" source type.

EMA ran two (2) sets of two (2) separate model runs which calculated concentration values for 24-hour and annual (period) averaging times. Each model run calculated pollutant concentrations from a single source group, "all," consisting of all of the proposed emission units. All emission parameters for each of the emission units were modeled as presented in Appendix J (Table 1 and Table 2), and used hourly emission rates that were scaled over the appropriate time frame. The use of the scaled hourly emissions allows accurate emission calculations from those sources which operate less than 24 hours per day or less than 8,760 hours per year, but which have no limit as to when they operate during a given 24-hour period or over the year.

2.2.2.1.3. Receptors

One (1) set of discrete receptors and three (3) cartesian receptor grids were used.

A single discrete receptor set, consisting of receptors placed at approximate 50 meter intervals along the Project mine and process area boundary, was used. Appendix K, Plate 1, shows the locations of each of these discrete receptors located along the Project mine and process area boundary in relation to the source areas for each of the emission units.

The coarsest receptor grid was a 19 by 19, 1,000-meter spaced, cartesian receptor grid which used even 1000-meter UTM coordinates, and which covered approximately 125 square miles around the Project area roughly centered on the Project mine and process area. A finer, 21 by 21, 250-meter spaced, cartesian receptor which used even 250-meter UTM coordinates, and which was also roughly centered on the Project mine and process area, was also used. The finest receptor grid was an 11 by 21, 100-meter spaced cartesian grid, placed around the southwest corner of the Project mine and process area in those areas of higher concentrations near the Project mine and process area boundary, using evenly spaced 100-meter UTM coordinates. Appendix K, Plate 2, shows the locations of each of these receptor grids in relation to the discrete receptors located along the Project mine and process area boundary.

Elevations for all of the discrete receptors and receptors in the cartesian receptor grids were taken from the USGS Digital Elevation Model (DEM) data for the following 7.5 Minute Series (Topographic) Maps, as applicable:

- Hedges, CA Quadrangle;
- Ogilby, CA Quadrangle;
- Quartz Peak, CA Quadrangle;
- Picacho SW, CA Quadrangle;
- Picacho Peak, CA Quadrangle; and
- Araz, CA Quadrangle.

The DEM data was converted to "XYZ" format, and directly imported into the model by the Trinity Breeze Interface. The elevation for each of the receptors was interpolated by the Interface.

2.2.2.1.4. Meteorological Data

Pursuant to discussions with the ICAPCD, EMA utilized surface meteorological data for the year 1989 from the National Weather Service (NWS) Yuma Surface Station (Yuma, AZ), combined with upper air data (also for 1989) from the NWS Tucson Upper Air Station (Tucson, AZ).

The Yuma Surface Station is the NWS-operated, 24-hour station located closest to the Project, approximately 20 miles south-southwest of the Project mine and process area. Given the proximity and similar elevations between Yuma and the Project, the Yuma data was expected to be reasonably representative of the Project mine and process area. According to meteorologists at the National Climatic Data Center (NCDC), 1989 was the last year of complete data from the Yuma Station, and as such was the year selected.

The NWS does not currently maintain an upper air station in Yuma, and does not have 1989 upper air data for Yuma. The Marine Corps Air Station (MCAS), Yuma does collect some upper air data, but the MCAS does not collect nor maintain complete upper air data records. Although the Tucson Upper Air Station is not as proximate to the Project area as a few other sites with upper air data, it is the closest site to the project area for which upper air data was believed to be representative of upper air conditions found in the Project area. In addition, a complete 1989 upper air data set was available for Tucson.

2.2.2.1.5. Results of PM_{10} Modeling

The results of the 24-hr runs (runs 0959XI36.DOC and 0959XI38.DOC) are presented in Appendix L-1 and Appendix L-2. The modelled high, at a point near the center of the Project mine and process area, was 68.2$\mu g/m^3$. The modelled high at a point accessible to the public, a "fence-line" receptor

near the southwestern boundary of the Project mine and process area, was 29.6 $\mu g/m^3$, below both the California and federal 24-hour AAQSs (see Table 2), even when the background PM_{10} level calculated from the Mesquite Mine (19.9 $\mu g/m^3$, (Environmental Solutions, Inc., 1994)) is added. Appendix K, Plate 3, provides a map of the fenced boundary of the Project mine and process area (equivalent to the discrete receptors) and contours for the combined results of the 24-hour model runs.

Calculated 24-hour ambient concentrations at distances greater than 3,750 meters (2.3 miles) from the Project mine and process area boundary were universally below 5 $\mu g/m^3$.

The results of the annual runs (runs 0959XI37.DOC and 0959XI39.DOC) are presented in Appendix L-3 and Appendix L-4. The modelled high, at a point again near the center of the Project mine and process area, was 30.0 $\mu g/m^3$. The modelled high at a point accessible to the public, again a "fence-line" receptor near the southwestern boundary of the Project mine and process area, was 5.3 $\mu g/m^3$, well below both the California and federal annual AAQSs (see Table 2), even when the background PM_{10} level calculated from the Mesquite Mine (19.9 $\mu g/m^3$) is added. Appendix K, Plate 4, provides a map of the fenced boundary of the Project mine and process area (equivalent to the discrete receptors) and contours for the combined results of the annual model runs.

2.2.2.2. Criteria Air Pollutants Other Than PM_{10}

Computer modelling of Project emissions to estimate maximum ambient air concentrations of criteria air pollutants other than PM_{10} has not been undertaken. However, some general observations regarding the potential ambient air quality impacts resulting from the Proposed Action activities within the Project mine and process area may be inferred through comparisons with modelling done for on-site activities for the proposed Mesquite Regional Landfill (U.S. Bureau of Land Management, 1994a). Because the emissions of gaseous pollutants are comparable between the two projects (Project-to-landfill ratios are 1.22:1 for NO_2; 1.64:1 for SO_2; and 1:1.32 for CO); the ratios of stationary to fugitive emissions generally similar; and the maximum, off-site, ground-level concentrations of the gaseous air pollutants calculated for the landfill in the reference year (year 16) are so low compared to the regulatory standards (all are less than two (2) percent of the regulatory standard), emissions of NO_2, SO_2, or CO by the Proposed Action are very unlikely to violate any applicable ambient air quality standard for these pollutants.

This page intentionally left blank
for reproduction purposes.

3. REFERENCES

Environmental Solutions, Inc., 1994: Air Quality Analysis for the Mesquite Regional Landfill, March 1994.

EPA, 1985: AP-42; Compilation of Air Pollutant Emission Factors; Environmental Protection Agency, Washington, D.C.

Schulze, Richard H., 1991: Practical Guide to Air Dispersion Modeling. Trinity Consultants, Inc., Dallas, Texas.

U.S. Bureau of Land Management and the Imperial County Planning and Building Department, 1994a: Air Quality Assessment Report, Mesquite Regional Landfill (Appendix F), October 1994.

This page intentionally left blank
for reproduction purposes.

APPENDIX A

MASTER LIST OF SOURCES

Chemgold Imperial Project
Imperial County, California

Air Pollutant Emission Inventory

Master List of All Quantifiable Emission Sources and Pollutants

Emission Unit No.	Emission Unit Description	Pollutants
Emission Unit Group 1: Mining Activity		
1.001	Drilling - Waste Rock	PM10, PM-Based HAPs
1.002	Drilling - Ore	PM10, PM-Based HAPs
1.003	Blasting - Waste Rock	PM10, PM-Based HAPs
1.004	Blasting - Ore	PM10, PM-Based HAPs
1.005	Waste Rock Loading	PM10, PM-Based HAPs
1.006	Ore Loading	PM10, PM-Based HAPs
1.007	Waste Rock Dumping	PM10, PM-Based HAPs
1.008	Ore Dumping	PM10, PM-Based HAPs
1.009	Waste Rock Dozing	PM10, PM-Based HAPs
1.010	Waste Rock Hauling	PM10, PM-Based HAPs
1.011	Ore Hauling	PM10, PM-Based HAPs
1.012	Ammonium Nitrate Prill Silo Loading	PM/PM10
1.013	Ammonium Nitrate Prill Silo Unloading	PM/PM10
1.014	Wind Erosion (Waste Rock Stockpile)	PM10, PM-Based HAPs
1.015	Wind Erosion (Soil Stockpiles)	PM10, PM-Based HAPs
1.016	Haul Truck (Combustion)	CO, PM10, VOC/ROGs, SOx, NOx, HAPs
1.017	Mine Dozer (Combustion)	CO, PM10, VOC/ROGs, SOx, NOx, HAPs
1.018	Drill Rig (Combustion)	CO, PM10, VOC/ROGs, SOx, NOx, HAPs
1.019	Loader (Combustion)	CO, PM10, VOC/ROGs, SOx, NOx, HAPs
1.020	Clean-Up Loader (Combustion)	CO, PM10, VOC/ROGs, SOx, NOx, HAPs
Emission Unit Group 2: Heap Leaching Activity		
2.001	Portable R-O-M Lime Silo Loading	PM/PM10
2.002	Portable R-O-M Lime Hopper Loading	PM/PM10
2.003	Lime Application to Ore	PM/PM10
2.004	Ore Ripping/Spreading/Dozing	PM10, PM-Based HAPs
2.005	Grader (Combustion)	CO, PM10, VOC/ROGs, SOx, NOx, HAPs
2.006	Heap Leach Dozer (Combustion)	CO, PM10, VOC/ROGs, SOx, NOx, HAPs
2.007	Cyanide Application and Leaching	HCN
2.008	Pregnant Solution Pond	HCN
2.009	Barren Solution Pond	HCN
2.010	Wind Erosion (Heap Leach Pad) - Non-Leach	PM10, PM-Based HAPs
2.011	Wind Erosion (Heap Leach Pad) - Leach	PM10, PM-Based HAPs
Emission Unit Group 3: Process Plant		
3.001	Carbon Adsorption Tank 1	HCN
3.002	Carbon Adsorption Tank 2	HCN
3.003	Carbon Adsorption Tank 3	HCN
3.004	Carbon Adsorption Tank 4	HCN
3.005	Carbon Adsorption Tank 5	HCN
3.006	Acid Wash Tank	HCl
3.007	Cyanide Make-up Tank	HCN
3.008	Strip Tank	HCN
3.009	Electrowinning Cell	HCN
Emission Unit Group 4: Refining		
4.001	Mercury Retort Furnace (Electric)	HAPs
Emission Unit Group 5: Laboratory		
5.001	Jaw Crusher	PM10, PM-Based HAPs
5.002	Pulverizer	PM10, PM-Based HAPs
5.003	Fume Hood	HCN
5.004	Waste Acid Tank	HCl
Emission Unit Group 6: Shop Area		
6.001	Main Diesel Tank 1	VOC/ROGs, HAPs
6.002	Street Diesel Tank	VOC/ROGs, HAPs
6.003	Unleaded Gasoline Tank	VOC/ROGs, HAPs
6.004	Coolant Tank	VOC/ROGs, HAPs

Chemgold Imperial Project
Air Pollutant Emission Inventory
Master List of All Quantifiable Emission Sources and Pollutants

Emission Unit No.	Emission Unit Description	Pollutants
Emission Unit Group 7: Mine & Process Area Support Activities		
7.001	Water Truck (Combustion)	CO, PM10, VOC/ROGs, SOx, NOx, HAPs
7.002	Water Truck Traffic	PM10, PM-Based HAPs
7.003	Backup Diesel-Fueled Generator	CO, PM10, VOC/ROGs, SOx, NOx, HAPs
Emission Unit Group 8: Other Mobile Emission Units		
8.001	On-Site Delivery Truck Traffic	PM10, PM-Based HAPs
8.002	On-Site Light Vehicle Traffic	PM10, PM-Based HAPs
8.003	Off-Site Delivery Truck Traffic	PM/PM10
8.004	Off-Site Light Vehicle Traffic	PM/PM10

APPENDIX B

PROJECT INFORMATION - MAXIMUM 24-HOUR OPERATIONS

Imperial Project
Imperial County, California

Air Pollutant Emission Inventory - Daily (24-Hr) Operation

Project Information

Factor	Value	Units	Source
Material moisture content (M) - Ore	3.67	%	Chemgold
Material moisture content (M) - Waste Rock	3.67	%	Chemgold
Material moisture content (M) - Lime	1.00	%	Chemgold
Material silt content (s) - Ore	1.26	%	Chemgold
Material silt content (s) - Waste Rock	1.40	%	Chemgold
Material silt content (s) - Lime	100.00	%	Chemgold
Silt content of road surface material (s) - Project Roads	1.26	%	Chemgold
Sulfur Content of Gas Burned (S) - LPG	0	gr/100 ft3 (gas vapor)	Chemgold
Mined Material	1.30E+05	tons/time	Chemgold
Waste to Ore Ratio	3.000	1.000	Chemgold
Mined Ore	3.25E+04	tons/time	Calc. - Percentage * Throughput
Percentage Ore	25%		Calc. - Ore:Waste Ratio
Mined Waste	9.75E+04	tons/time	Calc. - Percentage * Throughput
Percentage Waste	75%		Calc. - Ore:Waste Ratio
Ore Haul Truck Load Size	240	tons/load	Chemgold
Loads of Ore/Unit Time	135.42	loads/time	Calc. - Mined Ore / tons/load
Waste Rock Haul Truck Load Size	240	tons/load	Chemgold
Loads of Waste Rock/Unit Time	406.25	loads/time	Calc. - Mined Waste / tons/load
Chemgold Operational Hours	354	days/yr	Chemgold
Chemgold Operational Hours	22	hrs/day	Chemgold

Imperial Project
Imperial County, California

Air Pollutant Emission Inventory - Daily (24-Hr) Operation

General Information

Factor	Value	Units	Source
Domes Study NaCN Soln. Temp	2.00	C	Domes Study (1990)
Domes Study NaCN Soln. Vapor Pressure	289.00	mmHg	Domes Study (1990)
Domes Study NaCN Soln. Conc.	65.30	ppm (as CN)	Domes Study (1990)
Domes Study NaCN Soln. pH	11.40		Domes Study (1990)
Domes Study HCN Conc.	0.01	HCN Conc.	Domes Study (1990)
Mean wind speed (U) inside pit	3.00	MPH	Yuma Met Data
Mean wind speed (U)	6.00	MPH	Yuma Met Data
TSP particle size multiplier (PM<30µm)(K_{TSP}) - Drop Sources	0.74	(dimensionless)	AP-42
PM_{10} particle size multiplier (K_{PM10}) - Drop Sources	0.35	(dimensionless)	AP-42
No. days with at least 0.01 in. of precipitation/year (p)	0.00	da/yr	Assume - No Precip. on Worst Case Day
% of time Avg. windspeed greater than 5.4 m/s (f)	9.10	%	Calc. from Met Data (Yuma/Tucson)
Sulfur Content of Gas Burned (S) - Diesel	0.05		CARB Requirement
Diesel Fuel Heat Input Rating	0.133936	mmBTU/gal	AP-42
Molecular Weight of HCN (MW_{HCN})	27.00		CRC Handbook
Molecular Weight of CN (MW_{CN})	26.00		CRC Handbook
Days/Unit Time	1.00	days/time	
Hours/Unit Time	24.00	hours/time	
Months/Unit Time	0.03	months/time	

Air Pollutant Emission Inventory - Daily (24-Hr) Operation

Emission Unit Specific Information

	Factor	Value	Units	Source
Emission Unit Group 1: Mining Activity				
1.001	***Drilling - Waste Rock***			
	Tons of Waste Rock Blasted/Hole	3,303.00	tons/hole	Chemgold
	Holes Drilled/Unit Time	27.00	holes/time	Chemgold
	Emission Control Factor (ECF)	85%	(Water Shrouding, Negative Pressure, Feed Cyclone Separator)	Chemgold
1.002	***Drilling - Ore***			
	Tons of Ore Blasted/Hole	3,303.00	tons/hole	Chemgold
	Holes Drilled/Unit Time	9.00	holes/time	Chemgold
	Emission Control Factor (ECF)	85%	(Water Shrouding, Negative Pressure, Feed Cyclone Separator)	Chemgold
1.003	***Blasting - Waste Rock***			
	Horizontal Area of Blast (A)	145,656	sq.ft.	Chemgold
	Drilled Holes/Blast	126	holes/blast	Chemgold
	Blasts/Unit Time	1.00	blasts/time	Calc. - Holes/time / blasts/hole
	Emission Control Factor (ECF)	0%	(Uncontrolled)	Chemgold
1.004	***Blasting - Ore***			
	Horizontal Area of Blast (A)	145,656	sq.ft.	Chemgold
	Drilled Holes/Blast	126	holes/blast	Chemgold
	Blasts/Unit Time	0.00	blasts/time	Calc. - As Above
	Emission Control Factor (ECF)	0%	(Uncontrolled)	Chemgold
1.005	***Waste Rock Loading***			
	Tons Waste Rock/Unit Time	9.75E+04	tons/time	Project Information
	Emission Control Factor (ECF)	0%	(Uncontrolled)	Chemgold
1.006	***Ore Loading***			
	Tons Ore/Unit Time	3.25E+04	tons/time	Project Information
	Emission Control Factor (ECF)	0%	(Uncontrolled)	Chemgold
1.007	***Waste Rock Dumping***			
	Tons Waste Rock/Unit Time	9.75E+04	tons/time	Project Information
	Emission Control Factor (ECF)	0%	(Uncontrolled)	Chemgold
1.008	***Ore Dumping***			
	Tons Ore/Unit Time	3.25E+04	tons/time	Project Information
	Emission Control Factor (ECF)	0%	(Uncontrolled)	Chemgold
1.009	***Waste Rock Dozing***			
	Hours Dozing/Unit Time	21.42	hours/time	See 1.017
	Emission Control Factor (ECF)	0%	(Uncontrolled)	Chemgold

	Factor	Value	Units	Source
1.010	***Waste Rock Hauling***			
	Mean Vehicle Speed (S)	22.9	MPH	Chemgold
	Mean Vehicle Weight (W)	295.00	tons	Chemgold
	Mean Number of Wheels (w)	6	wheels	Chemgold
	Vehicle Miles Traveled/Load	2.14	VMT/load	Chemgold
	Loads/Unit Time	406.25	loads/time	Project Information
	Vehicle Miles Traveled/Unit Time	869.38	VMT/time	Calc. - Loads/time * VMT/Load
	Emission Control Factor (ECF)	90%	(Watering)	Chemgold
1.011	***Ore Hauling***			
	Mean Vehicle Speed (S)	22.9	MPH	Chemgold
	Mean Vehicle Weight (W)	295.00	tons	Chemgold
	Mean Number of Wheels (w)	6	wheels	Chemgold
	Vehicle Miles Traveled/Load	2.14	VMT/load	Chemgold
	Loads/Unit Time	135.42	loads/time	Project Information
	Vehicle Miles Traveled/Unit Time	289.79	VMT/time	Calc. - Loads/time * VMT/Load
	Emission Control Factor (ECF)	90%	(Watering)	Chemgold
1.012	***Ammonium Nitrate Prill Silo Loading***			
	Tons/Delivery	25	tons/delivery	Chemgold
	Deliveries/Unit Time	1.00	deliveries/time	Chemgold - Max. DPD
	Tons/Unit Time	25.00	tons/time	Calc. - del/time * tons/delivery
	Emission Control Factor (ECF)	0%	(Uncontrolled)	Chemgold
1.013	***Ammonium Nitrate Prill Silo Unloading***			
	Pounds Used/Hole	826	lbs/hole	Chemgold
	Tons Used/Unit Time	14.87	tons/time	Calc. - holes blasted/time * lbs/hole /2000
	Emission control factor (ECF)	0%	(Uncontrolled)	Chemgold
1.014	***Wind Erosion (Waste Rock Stockpile)***			
	Size of Active Waste Rock Stockpile	40	acres	Chemgold
	Emission control factor (ECF)	0%	(Uncontrolled)	Chemgold
1.015	***Wind Erosion (Soil Stockpiles)***			
	Size of Active Soil Stockpile	10	acres	Chemgold
	Emission control factor (ECF)	0%	(Uncontrolled)	Chemgold
1.016	***Haul Truck (Combustion)***			
	Availability of Individual Units	85%		Chemgold
	Utilization of Individual Units	87%		Chemgold
	Individual Unit Hours Used/Unit Time	17.75	hrs/time	Calc. - Avail. * Util. * hrs/time (Proj. Inf.)
	Individual Unit Fuel Consumption/Hour	0.044	1000 gal/hr	Chemgold
	No. Units	8	Units	Chemgold
	Total Fuel Consumption/Unit Time	6.25	1000 gal/time	Calc. - fuel use/hr * units * hrs/time
	Emission control factor (ECF)	0%	(Uncontrolled)	Chemgold

Imperial Project
Air Pollutant Emission Inventory - Daily (24-Hr) Operation
Project Variables - Unit Specific

	Factor	Value	Units	Source
1.017	***Mine Dozer (Combustion)***			
	Availability of Individual Units	97%		Chemgold
	Utilization of Individual Units	92%		Chemgold
	Individual Unit Hours Used/Unit Time	21	hrs/time	Calc. - Avail. * Util. * hrs/time (Proj. Inf.)
	Individual Unit Fuel Consumption/Hour	0.02	1000 gal/hr	Chemgold
	No. Units	1	Unit	Chemgold
	Total Fuel Consumption/Unit Time	0.43	1000 gal/time	Calc. - fuel use/hr * units * hrs/time
	Emission control factor (ECF)	0%	(Uncontrolled)	Chemgold
1.018	***Drill Rig (Combustion)***			
	Hours/Hole Drilled	0.67	hours/hole	Chemgold
	Hours/Unit Time	24.00	hours/time	Calc. - holes/time (Proj. Inf.) * hrs/hole
	Fuel Consumption/hour	20	gal/hr	Chemgold
	Fuel Consumption/Unit Time	480	gal/time	Calc. - hrs/time * gal/time
	Emission control factor (ECF)	0%	(Uncontrolled)	Chemgold
1.019	***Loader (Combustion)***			
	Availability of Individual Units	85%		Chemgold
	Utilization of Individual Units	55%		Chemgold
	Individual Unit Hours Used/Unit Time	11	hrs/time	Calc. - Avail. * Util. * hrs/time (Proj. Inf.)
	Individual Unit Fuel Consumption/Hour	0.048	1000 gal/hr	Chemgold
	No. Units	1	Unit	Chemgold
	Total Fuel Consumption/Unit Time	0.54	1000 gal/time	Calc. - fuel use/hr * units * hrs/time
	Emission control factor (ECF)	0%	(Uncontrolled)	Chemgold
1.020	***Clean-Up Loader (Combustion)***			
	Availability of Individual Units	85%		Chemgold
	Utilization of Individual Units	25%		Chemgold
	Individual Unit Hours Used/Unit Time	5	hrs/time	Calc. - Avail. * Util. * hrs/time (Proj. Inf.)
	Individual Unit Fuel Consumption/Hour	0.028	1000 gal/hr	Chemgold
	No. Units	1	Unit	Chemgold
	Total Fuel Consumption/Unit Time	0.14	1000 gal/time	Calc. - fuel use/hr * units * hrs/time
	Emission control factor (ECF)	0%	(Uncontrolled)	Chemgold

Emission Unit Group 2: Heap Leaching Activity

2.001	***Portable R-O-M Lime Silo Loading***			
	Silo Capacity	500	tons	Chemgold
	Tons/Delivery	25	tons/delivery	Chemgold
	Deliveries/Unit Time	2.00	deliveries/time	Calc. - tons/time (2.003) / tons/delivery
	Tons/Unit Time	50.00	tons/time	Calc. - tons/delivery * del./time
	Emission control factor (ECF)	99%	(Baghouse)	Chemgold
2.002	***Portable R-O-M Lime Hopper Loading***			
	Tons/Unit Time	32.50	tons/time	See 2.003 Lime Application to Ore
	Emission control factor (ECF)	0%	(Uncontrolled)	Chemgold

Imperial Project
Air Pollutant Emission Inventory - Daily (24-Hr) Operation
Project Variables - Unit Specific

	Factor	Value	Units	Source
2.003	***Lime Application to Ore***			
	Tons/Load of Ore	0.24	tons/load	Chemgold
	Loads of Ore/Unit Time	135.42	loads/time	See 1.008B Ore Hauling
	Tons of Lime Used/Unit Time	32.50	tons/time	Calc. - tons/load * loads/time
	Emission Control Factor (ECF)	70%	(Water Sprays)	Chemgold
2.004	***Ore Ripping/Spreading/Dozing***			
	Hours Dozing/Unit Time	21.4	hours/time	See 2.006 Heap Leach Dozer (Comb.)
	Emission Control Factor (ECF)	0%	(Uncontrolled)	Chemgold
2.005	***Grader (Combustion)***			
	Availability of Individual Units	85%		Chemgold
	Utilization of Individual Units	90%		Chemgold
	Individual Unit Hours Used/Unit Time	18	hrs/time	Calc. - Avail. * Util. * hrs/time (Proj. Inf.)
	Individual Unit Fuel Consumption/Hour	0.01	1000 gal/hr	Chemgold
	No. Units	1	Unit	Chemgold
	Total Fuel Consumption/Unit Time	0.18	1000 gal/time	Calc. - fuel use/hr * units * hrs/time
	Emission control factor (ECF)	0%	(Uncontrolled)	Chemgold
2.006	***Heap Leach Dozer (Combustion)***			
	Availability of Individual Units	97.0%		Chemgold
	Utilization of Individual Units	92%		Chemgold
	Individual Unit Hours Used/Unit Time	21.4	hrs/time	Calc. - Avail. * Util. * hrs/time (Proj. Inf.)
	Individual Unit Fuel Consumption/Hour	0.02	1000 gal/hr	Chemgold
	No. Units	1	Unit	Chemgold
	Total Fuel Consumption/Unit Time	0.43	1000 gal/time	Calc. - fuel use/hr * units * hrs/time
	Emission control factor (ECF)	0%	(Uncontrolled)	Chemgold
2.007	***Cyanide Application and Leaching***			
2.010	***Wind Erosion (Heap Leach Pad) - Non-Leach***			
2.011	***Wind Erosion (Heap Leach Pad) - Leach***			
	Size of Heap	329	Acres (Max. Size of Heap)	Chemgold
	Area of Heap Under Leach	20.4	Acres	Chemgold
	Area of Fresh Ore Not Under Leach	20.4	Acres	Chemgold
	Years/Unit Time	0.0027	yr/time	Calc. - Days/time (Proj. Info.) / 365
	Non-Leach Area Emission Control Factor (ECF_{Non})	0%	(Uncontrolled)	Chemgold
	Leachate Emission Control Factor (ECF_{Leach})	95%	(Heap Under Leach)	Mesquite Landfill EIS
	HCN Emission Control Factor (ECF_{HCN})	0%	(Uncontrolled)	Chemgold
2.008	***Pregnant Solution Pond***			
	Surface Area of Pond	54,400	sq. ft.	Chemgold
	Average pH of Pond	10.6		Chemgold
	NaCN Conc. in Pond	25	ppm	Chemgold
	Imperial Soln. Temp.	30	C	Chemgold
	Imperial Soln. Vapor Pressure	796	mmHg	Calc. - Vapor Press. of HCN @ Temp.
	Imperial Soln. Conc.	13.27	ppm (as CN)	Calc. - CN Conc. at NaCN Soln. Conc.
	Imperial HCN Conc.	4.00%	HCN Conc.	Calc. - Volatilization Curve (Domes)
	Days/Unit Time	1	da/time	Project Information
	Emission Control Factor (ECF)	0.00%	(Uncontrolled)	Chemgold

Imperial Project
Air Pollutant Emission Inventory - Daily (24-Hr) Operation
Project Variables - Unit Specific

	Factor	Value	Units	Source
2.009	***Barren Solution Pond***			
	Surface Area of Pond	54,400	sq. ft.	Chemgold
	Average pH of Pond	10.6		Chemgold
	NaCN Conc. in Pond	25	ppm	Chemgold
	Imperial Soln. Temp.	28.9	C	Chemgold
	Imperial Soln. Vapor Pressure	795	mmHg	Calc. - Vapor Press. of HCN @ Temp.
	Imperial Soln. Conc.	13.27	ppm (as CN)	Calc. - CN Conc. at NaCN Soln. Conc.
	Imperial HCN Conc.	5.00%	HCN Conc.	Calc. - Volatilization Curve (Domes)
	Days/Unit Time	1	da/time	Project Information
	Emission Control Factor (ECF)	0.00%	(Uncontrolled)	Chemgold

Emission Unit Group 3: Process Plant

3.001-5	***Carbon Adsorption Tanks 1-5***			
	No. Units	5	Units	Chemgold
	Surface Area of Pond	100	sq. ft.	Chemgold
	Average pH of Pond	10.6		Chemgold
	NaCN Conc. in Pond	25	ppm	Chemgold
	Imperial Soln. Temp.	30	C	Chemgold
	Imperial Soln. Vapor Pressure	796	mmHg	Calc. - Vapor Press. of HCN @ Temp.
	Imperial Soln. Conc.	13.27	ppm (as CN)	Calc. - CN Conc. at NaCN Soln. Conc.
	Imperial HCN Conc.	4.00%	HCN Conc.	Calc. - Volatilization Curve (Domes)
	Days/Unit Time	1	da/time	Project Information
	Emission Control Factor (ECF)	0%	(Uncontrolled)	Chemgold
3.006	***Acid Wash Tank***			
	Acid strength (%)	5%		Chemgold
	Specific Gravity of HCl	1.16		CRC Handbook
	Weight of H_2O	8.345	#/gal	CRC Handbook
	Consumption - Gal/Month	6,083	gal/mo	Chemgold
	Consumption - Gal/Unit Time	200	gal/time	Calc. - gal/mo * mo/time
	Consumption - Lbs/Unit Time	1,936	lbs/time	Calc. - gal/time * #/gal * Spec. Grav.
	Emission control factor (ECF)	0%	(Uncontrolled)	Chemgold
3.007	***Cyanide Make-up Tank***			
	Surface Area of Pond	113	sq. ft.	Chemgold
	Average pH of Pond	12		Chemgold
	NaCN Conc. in Pond	240,000.00	ppm	Chemgold
	Imperial Soln. Temp.	28.9	C	Chemgold
	Imperial Soln. Vapor Pressure	795	mmHg	Calc. - Vapor Press. of HCN @ Temp.
	Imperial Soln. Conc.	127,346.94	ppm (as CN)	Calc. - CN Conc. at NaCN Soln. Conc.
	Imperial HCN Conc.	0.00%	HCN Conc.	Calc. - Volatilization Curve (Domes)
	Days/Unit Time	1	days/time	Project Information
	Emission Control Factor (ECF)	0%	(Uncontrolled)	Chemgold

Imperial Project
Air Pollution Emission Inventory
Project Variables - Unit Specific

	Factor	Value	Units	Source
3.008	***Strip Tank***			
	Surface Area of Pond	38.50	sq. ft.	Chemgold
	Average pH of Pond	13.5		Chemgold
	NaCN Conc. in Pond	2,000.00	ppm	Chemgold
	Imperial Soln. Temp.	30	C	Chemgold
	Imperial Soln. Vapor Pressure	800	mmHg	Calc. - Vapor Press. of HCN @ Temp.
	Imperial Soln. Conc.	1061.22	ppm (as CN)	Calc. - CN Conc. at NaCN Soln. Conc.
	Imperial HCN Conc.	0.00%	HCN Conc.	Calc. - Volatilization Curve (Domes)
	Days/Year Under Leach	1	da/yr	Project Information
	Emission Control Factor (ECF)	0%	(Uncontrolled)	Chemgold
3.009	***Electrowinning Cell***			
	Surface Area of Pond	24.00	sq. ft.	Chemgold
	Average pH of Pond	13.5		Chemgold
	NaCN Conc. in Pond	250	ppm	Chemgold
	Imperial Soln. Temp.	369.3	C	Chemgold
	Imperial Soln. Vapor Pressure	825	mmHg	Calc. - Vapor Press. of HCN @ Temp.
	Imperial Soln. Conc.	132.65	ppm (as CN)	Calc. - CN Conc. at NaCN Soln. Conc.
	Imperial HCN Conc.	0.00%	HCN Conc.	Calc. - Volatilization Curve (Domes)
	Days/Unit Time	1	days/time	Project Information
	Emission Control Factor (ECF)	0%	(Uncontrolled)	Chemgold

Emission Unit Group 4: Refining

4.001	***Mercury Retort Furnace (Electric)***			
	Utilization of Individual Units	25%		Chemgold
	Individual Unit Hours Used/Unit Time	6	hrs/time	Calc. - Util. * hrs/time (Proj. Inf.)
	No. Units	1	Unit	Chemgold
	Emission control factor (ECF)	0%	(Uncontrolled)	Chemgold
	Mercury Emissions in grams/hour	1.87E-03	g/hr	Chemgold
	Mercury Emissions in pounds/hour	4.13E-06	lbs/hr	Calc. - g/hr to lbs/hr conversion

Emission Unit Group 5: Laboratory

5.001	***Jaw Crusher***			
	Hours/Unit Time	6	hrs/time	Chemgold
	Tons/Hour	0.23	tph	Chemgold
	Tons Processed/Unit Time	1.31	tons/time	Calc. - tph * hrs/time
	Emission control factor (ECF)	0%	(Uncontrolled)	Chemgold
5.002	***Pulverizer***			
	Hours/Unit Time	6	hrs/time	Chemgold
	Tons/Hour	0.23	tph	Chemgold
	Tons Processed/Unit Time	1.31E+00	tons/time	Calc. - tph * hrs/time
	Emission control factor (ECF)	0%	(Uncontrolled)	Chemgold

Imperial Project
Air Pollution Emission Inventory
Project Variables - Unit Specific

	Factor	Value	Units	Source
5.003	***Fume Hood***			
	Surface Area of Pond	0.79	sq. ft.	Chemgold
	Average pH of Pond	12		Chemgold
	NaCN Conc. in Pond	240,000.00	ppm	Chemgold
	Imperial Soln. Temp.	12	C	Chemgold
	Imperial Soln. Vapor Pressure	790	mmHg	Calc. - Vapor Press. of HCN @ Temp.
	Imperial Soln. Conc.	127,346.94	ppm (as CN)	Calc. - CN Conc. at NaCN Soln. Conc.
	Imperial HCN Conc.	0.00%	HCN Conc.	Calc. - Volatilization Curve (Domes)
	Days/Unit Time	1	days/time	Project Information
	Emission Control Factor (ECF)	0%	(Uncontrolled)	Chemgold
5.004	***Waste Acid Tank***			
	Emissions calculated as part of Emission Unit No. 3.006			
	Emission Unit Group 6: Shop Area			
6.001	***Main Diesel Tank 1***			
	Tank Height (Vertical Tank)	20	ft	Chemgold
	Tank Diameter (Vertical Tank)	19	ft	Chemgold
	Liquid Height (Vertical Tank)	19	ft	Chemgold
	Avg. Liquid Height (Vertical Tank)	15	ft	Chemgold
	Working Volume	40,000	gal	Chemgold
	Turnovers/yr	100	turnovers/yr	Calc. - Throughput / tank size
	Throughput	4,016,000	gal/yr	Chemgold
	Standing Losses	7.04	lbs/yr (VOCs)	Calc. - EPA Tanks
	Working Losses	63.85	lbs/yr (VOCs)	Calc. - EPA Tanks
	Total Losses	70.89	lbs/yr (VOCs)	Calc. - EPA Tanks
	Standing Losses	0.02	lbs/da (VOCs)	Calc. - lbs/yr / hrs/yr * hrs/da
	Working Losses	0.17	lbs/da (VOCs)	Calc. - lbs/yr / hrs/yr * hrs/da
	Total Losses	0.19	lbs/da (VOCs)	Calc. - lbs/yr / hrs/yr * hrs/da
6.002	***Street Diesel Tank***			
	Tank Height (Vertical Tank)	10	ft	Chemgold
	Tank Diameter (Vertical Tank)	6	ft	Chemgold
	Liquid Height (Vertical Tank)	10	ft	Chemgold
	Avg. Liquid Height (Vertical Tank)	8	ft	Chemgold
	Working Volume	2,000	gal	Chemgold
	Turnovers/yr	55	turnovers/yr	Calc. - Throughput / tank size
	Throughput	109,600	gal/yr	Chemgold
	Standing Losses	0.28	lbs/yr (VOCs)	Calc. - EPA Tanks
	Working Losses	2.78	lbs/yr (VOCs)	Calc. - EPA Tanks
	Total Losses	3.06	lbs/yr (VOCs)	Calc. - EPA Tanks
	Standing Losses	0.0008	lbs/da (VOCs)	Calc. - lbs/yr / hrs/yr * hrs/da
	Working Losses	0.0076	lbs/da (VOCs)	Calc. - lbs/yr / hrs/yr * hrs/da
	Total Losses	0.0084	lbs/da (VOCs)	Calc. - lbs/yr / hrs/yr * hrs/da

Imperial Project
Air Pollutant Emission Inventory - Daily (24-Hr) Operation
Project Variables - Unit Specific

	Factor	Value	Units	Source
6.003	***Unleaded Gasoline Tank***			
	Tank Height (Vertical Tank)	10	ft	Chemgold
	Tank Diameter (Vertical Tank)	6	ft	Chemgold
	Liquid Height (Vertical Tank)	10	ft	Chemgold
	Avg. Liquid Height (Vertical Tank)	7	ft	Chemgold
	Working Volume	2,000	gal	Chemgold
	Turnovers/yr	21	turnovers/yr	Calc. - Throughput / tank size
	Throughput	41,200	gal/yr	Chemgold
	Standing Losses	625.94	lbs/yr (VOCs)	Calc. - EPA Tanks
	Working Losses	563.29	lbs/yr (VOCs)	Calc. - EPA Tanks
	Total Losses	1,189.23	lbs/yr (VOCs)	Calc. - EPA Tanks
	Standing Losses	1.71	lbs/da (VOCs)	Calc. - lbs/yr / hrs/yr * hrs/da
	Working Losses	1.54	lbs/da (VOCs)	Calc. - lbs/yr / hrs/yr * hrs/da
	Total Losses	3.26	lbs/da (VOCs)	Calc. - lbs/yr / hrs/yr * hrs/da
6.004	***Coolant Tank***			
	Shell Length (Horizontal Tank)	14	ft	Chemgold
	Tank Diameter (Horizontal Tank)	7	ft	Chemgold
	Working Volume	5,000	gal	Chemgold
	Turnovers/yr	1	turnovers/yr	Calc. - Throughput / tank size
	Throughput	5,000.00	gal/yr	Chemgold
	Standing Losses	0.18	lbs/yr (VOCs)	Calc. - EPA Tanks
	Working Losses	0.02	lbs/yr (VOCs)	Calc. - EPA Tanks
	Total Losses	0.20	lbs/yr (VOCs)	Calc. - EPA Tanks
	Standing Losses	0.00049	lbs/da (VOCs)	Calc. - lbs/yr / hrs/yr * hrs/da
	Working Losses	0.00005	lbs/da (VOCs)	Calc. - lbs/yr / hrs/yr * hrs/da
	Total Losses	0.00055	lbs/da (VOCs)	Calc. - lbs/yr / hrs/yr * hrs/da
	% Ethylene Glycol in Fluid	95%		Chemgold

Imperial Project
Air Pollutant Emission Inventory - Daily (24-Hr) Operation
Project Variables - Unit Specific

	Factor	Value	Units	Source
Emission Unit Group 7: Mine & Process Area Support Activities				
7.001	***Water Truck (Combustion)***			
	Availability of Individual Units	85%		Chemgold
	Utilization of Individual Units	49%		Chemgold
	Individual Unit Hours Used/Unit Time	10	hrs/time	Calc. - Avail. * Util. * hrs/time (Proj. Inf.)
	Individual Unit Fuel Consumption/Hour	0.019	1000 gal/hr	Chemgold
	No. Units	2	Unit	Chemgold
	Total Fuel Consumption/Unit Time	0.38	1000 gal/time	Calc. - fuel use/hr * units * hrs/time
	Emission control factor (ECF)	0%	(Uncontrolled)	Chemgold
7.002	***Water Truck Traffic***			
	Mean Vehicle Speed (S)	10	MPH	Chemgold
	Mean Vehicle Weight (W)	35	tons	Chemgold
	Mean Number of Wheels (w)	6	wheels	Chemgold
	Vehicle Miles Traveled/Trip	10.00	VMT	Chemgold
	Trips/Unit Time	2	trips/time	Chemgold
	Vehivle Miles Traveled/Unit Time	20	VMT/Unit Time	Calc. - VMT * trips/time
	Emission Control Factor (ECF)	95%	(Watering)	Chemgold
7.003	***Backup Diesel-Fueled Generator***			
	Engine Rating	750	hp	Calculated
	Engine Rating	500	kW	Chemgold
	Hours/Unit Time	-	hrs/time	Calc. - Avail. * Util. * hrs/time (Proj. Inf.)
	Fuel Consumption/Hour	9.2	gal/hr	Chemgold
	No. Units	1	units	Chemgold
	Fuel Consumption/Unit Time	-	gal/time	Calc. - fuel use/hr * units * hrs/time
	Emission control factor (ECF)	0%	(Uncontrolled)	Chemgold
Emission Unit Group 8: Other Mobile Emission Units				
8.001	***On-Site Delivery Truck Traffic***			
	Mean Vehicle Speed (S)	25	MPH	Chemgold
	Mean Vehicle Weight (W)	35	tons	Chemgold
	Mean Number of Wheels (w)	18	wheels	Chemgold
	Vehicle Miles Traveled/Trip	0.98	VMT	Chemgold
	Trips/Unit Time	4	trips/time	Chemgold
	Vehicle Miles Traveled/Unit Time	4	VMT/Unit Time	Calc. - VMT * trips/time
	Emission Control Factor (ECF)	90%	(Watering)	Chemgold
8.002	***On-Site Light Vehicle Traffic***			
	Mean Vehicle Speed (S)	25	MPH	Chemgold
	Mean Vehicle Weight (W)	7.2	tons	Chemgold
	Mean Number of Wheels (w)	5.08	wheels	Chemgold
	Vehicle Miles Traveled/Trip	1.5	VMT	Chemgold
	Trips/Unit Time	147	trips/time	Chemgold
	Vehivle Miles Traveled/Unit Time	221	VMT/Unit Time	Calc. - VMT * trips/time
	Emission Control Factor (ECF)	90%	(Watering)	Chemgold

Imperial Project
Air Pollutant Emission Inventory - Daily (24-Hr) Operation
Project Variables - Unit Specific

	Factor	Value	Units	Source
8.003	***Off-Site Delivery Truck Traffic***			
	Mean Vehicle Speed (S)	35	MPH	Chemgold
	Mean Vehicle Weight (W)	35	tons	Chemgold
	Mean Number of Wheels (w)	18	wheels	Chemgold
	Vehicle Miles Traveled/Trip	8.33	VMT	Chemgold
	Trips/Unit Time	4	trips/time	Chemgold
	Vehivle Miles Traveled/Unit Time	33	VMT/Unit Time	Calc. - VMT * trips/time
	Emission Control Factor (ECF)	80%	(Chemical Stabilizers)	Chemgold
8.004	***Off-Site Light Vehicle Traffic***			
	Mean Vehicle Speed (S)	35	MPH	Chemgold
	Mean Vehicle Weight (W)	7.2	tons	Chemgold
	Mean Number of Wheels (w)	4	wheels	Chemgold
	Vehicle Miles Traveled/Trip	8.33	VMT	Chemgold
	Trips/Unit Time	155	trips/time	Chemgold
	Vehivle Miles Traveled/Unit Time	1,291	VMT/Unit Time	Calc. - VMT * trips/time
	Emission Control Factor (ECF)	80%	(Chemical Stabilizers)	Chemgold

Metals Analysis

Ore-Based HAPs Emissions

Hazardous Air Pollutant	Analytical Results (ppm)	Calculated Emission Factor (lbs/lb)	Hazardous Air Pollutant	Analytical Results (ppm)	Calculated Emission Factor (lbs/lb)
Antimony (Sb)	32.80	3.28E-05	Lead (Pb)	13.25	1.33E-05
Arsenic (As)	179.75	1.80E-04	Manganese (Mn)	777.25	7.77E-04
Beryllium (Be)	2.00	2.00E-06	Mercury (Hg)	0.40	4.01E-07
Cadmium (Cd)	5.50	5.50E-06	Nickel (Ni)	25.00	2.50E-05
Chromium (Cr)	80.00	8.00E-05	Selenium (Se)	5.00	5.00E-06
Cobalt (Co)	11.50	1.15E-05			

Waste-Based HAPs Emissions

Hazardous Air Pollutant	Analytical Results (ppm)	Calculated Emission Factor (lbs/lb)	Hazardous Air Pollutant	Analytical Results (ppm)	Calculated Emission Factor (lbs/lb)
Antimony (Sb)	13.16	1.32E-05	Lead (Pb)	5.00	5.00E-06
Arsenic (As)	59.33	5.93E-05	Manganese (Mn)	607.67	6.08E-04
Beryllium (Be)	2.00	2.00E-06	Mercury (Hg)	0.40	3.97E-07
Cadmium (Cd)	5.00	5.00E-06	Nickel (Ni)	20.00	2.00E-05
Chromium (Cr)	109.00	1.09E-04	Selenium (Se)	5.00	5.00E-06
Cobalt (Co)	13.67	1.37E-05			

(Source: Bondar-Clegg Geotechnical Lab Report, 1995)

This page intentionally left blank
for reproduction purposes.

APPENDIX C

PROJECT INFORMATION - ANNUAL OPERATIONS

Imperial Project
Imperial County, California

Air Pollutant Emission Inventory - Annual Operations

Project Information

Factor	Value	Units	Source
Material moisture content (M) - Ore	3.67	%	Chemgold
Material moisture content (M) - Waste Rock	3.67	%	Chemgold
Material moisture content (M) - Lime	1.00	%	Chemgold
Material silt content (s) - Ore	1.26	%	Chemgold
Material silt content (s) - Waste Rock	1.40	%	Chemgold
Material silt content (s) - Lime	100.00	%	Chemgold
Silt content of road surface material (s) - Project Roads	1.26	%	Chemgold
Sulfur Content of Gas Burned (S) - LPG	0	gr/100 ft3 (gas vapor)	Chemgold
Mined Material	4.38E+07	tons/time	Chemgold
Waste to Ore Ratio	3.000	1.000	Chemgold
Mined Ore	1.10E+07	tons/time	Calc. - Percentage * Throughput
Percentage Ore	25%		Calc. - Ore:Waste Ratio
Mined Waste	3.29E+07	tons/time	Calc. - Percentage * Throughput
Percentage Waste	75%		Calc. - Ore:Waste Ratio
Ore Haul Truck Load Size	240	tons/load	Chemgold
Loads of Ore/Unit Time	45625.00	loads/time	Calc. - Mined Ore / tons/load
Waste Rock Haul Truck Load Size	240	tons/load	Chemgold
Loads of Waste Rock/Unit Time	136875.00	loads/time	Calc. - Mined Waste / tons/load
Chemgold Operations (days/unit time)	354	days/time	Chemgold
Chemgold Operations (hours/day)	22	hrs/day	Chemgold

Imperial Project
Imperial County, California

Air Pollutant Emission Inventory - Annual Operations

General Information

Factor	Value	Units	Source
Domes Study NaCN Soln. Temp	2	C	Domes Study (1990)
Domes Study NaCN Soln. Vapor Pressure	289	mmHg	Domes Study (1990)
Domes Study NaCN Soln. Conc.	65.3	ppm (as CN)	Domes Study (1990)
Domes Study NaCN Soln. pH	11.4		Domes Study (1990)
Domes Study HCN Conc.	0.50%	HCN Conc.	Domes Study (1990)
Mean wind speed (U) in Pit	3.0	MPH	Yuma Met Data
Mean wind speed (U)	6.0	MPH	Yuma Met Data
TSP particle size multiplier (PM<30µm)(K_{TSP}) - Drop Sources	0.74	(dimensionless)	AP-42
PM_{10} particle size multiplier (K_{PM10}) - Drop Sources	0.35	(dimensionless)	AP-42
No. days with at least 0.01 in. of precipitation/year (p)	25	da/yr	AP-42
% of time Avg. windspeed greater than 5.4 m/s (f)	9.10	%	Calc.from Met Data (Yuma/Tucson)
Sulfur Content of Gas Burned (S) - Diesel	0.05		CARB Requirement
Diesel Fuel Heat Input Rating	0.133936	mmBTU/gal	AP-42
Molecular Weight of HCN (MW_{HCN})	27		CRC Handbook
Molecular Weight of CN (MW_{CN})	26		CRC Handbook
Days/Unit Time	365	days/time	
Hours/Unit Time	8760.0	hours/time	
Months/Unit Time	12	months/time	

Air Pollutant Emission Inventory - Annual Operations

Emission Unit Specific Information

	Factor	Value	Units	Source
Emission Unit Group 1: Mining Activity				
1.001	***Drilling - Waste Rock***			
	Tons of Waste Rock Blasted/Hole	3,303.00	tons/hole	Chemgold
	Holes Drilled/Unit Time	9,945.50	holes/time	Calc. - mined tonage / tons/hole
	Emission Control Factor (ECF)	85%	(Water Shrouding, Negative Pressure, Feed Cyclone Separator)	Chemgold
1.002	***Drilling - Ore***			
	Tons of Ore Blasted/Hole	3,303.00	tons/hole	Chemgold
	Holes Drilled/Unit Time	3,315.17	holes/time	Calc. - mined tonage / tons/hole
	Emission Control Factor (ECF)	85%	(Water Shrouding, Negative Pressure, Feed Cyclone Separator)	Chemgold
1.003	***Blasting - Waste Rock***			
	Horizontal Area of Blast (A)	145,656	sq.ft.	Chemgold
	Drilled Holes/Blast	126	holes/blast	Chemgold
	Blasts/Unit Time	78.93	blasts/time	Calc. - Holes/time / blasts/hole
	Emission Control Factor (ECF)	0%	(Uncontrolled)	Chemgold
1.004	***Blasting - Ore***			
	Horizontal Area of Blast (A)	145,656	sq.ft.	Chemgold
	Drilled Holes/Blast	126	holes/blast	Chemgold
	Blasts/Unit Time	26.31	blasts/time	Calc. - As Above
	Emission Control Factor (ECF)	0%	(Uncontrolled)	Chemgold
1.005	***Waste Rock Loading***			
	Tons Waste Rock/Unit Time	3.29E+07	tons/time	Project Information
	Emission Control Factor (ECF)	0%	(Uncontrolled)	Chemgold
1.006	***Ore Loading***			
	Tons Ore/Unit Time	1.10E+07	tons/time	Project Information
	Emission Control Factor (ECF)	0%	(Uncontrolled)	Chemgold
1.007	***Waste Rock Dumping***			
	Tons Waste Rock/Unit Time	3.29E+07	tons/time	Project Information
	Emission Control Factor (ECF)	0%	(Uncontrolled)	Chemgold
1.008	***Ore Dumping***			
	Tons Ore/Unit Time	1.10E+07	tons/time	Project Information
	Emission Control Factor (ECF)	0%	(Uncontrolled)	Chemgold
1.009	***Waste Rock Dozing***			
	Hours Dozing/Unit Time	7,817.42	hours/time	See 1.017
	Emission Control Factor (ECF)	0%	(Uncontrolled)	Chemgold

	Factor	Value	Units	Source
1.010	***Waste Rock Hauling***			
	Mean Vehicle Speed (S)	22.9	MPH	Chemgold
	Mean Vehicle Weight (W)	295	tons	Chemgold
	Mean Number of Wheels (w)	6	wheels	Chemgold
	Vehicle Miles Traveled/Load	2.14	VMT/load	Chemgold
	Loads/Unit Time	136,875.00	loads/time	Project Information
	Vehicle Miles Traveled/Unit Time	292,912.50	VMT/time	Calc. - Loads/time * VMT/Load
	Emission Control Factor (ECF)	90%	(Watering)	Chemgold
1.011	***Ore Hauling***			
	Mean Vehicle Speed (S)	22.9	MPH	Chemgold
	Mean Vehicle Weight (W)	295	tons	Chemgold
	Mean Number of Wheels (w)	6	wheels	Chemgold
	Vehicle Miles Traveled/Load	2.14	VMT/load	Chemgold
	Loads/Unit Time	45,625.00	loads/time	Project Information
	Vehicle Miles Traveled/Unit Time	97,637.50	VMT/time	Calc. - Loads/time * VMT/Load
	Emission Control Factor (ECF)	90%	(Watering)	Chemgold
1.012	***Ammonium Nitrate Prill Silo Loading***			
	Tons/Delivery	25	tons/delivery	Chemgold
	Deliveries/Unit Time	219.00	deliveries/time	Calc. - tons/time (1.013) / tons/del.
	Tons/Unit Time	5,475.00	tons/time	Calc. - del/time * tons/delivery
	Emission Control Factor (ECF)	0%	(Uncontrolled)	Chemgold
1.013	***Ammonium Nitrate Prill Silo Unloading***			
	Pounds Used/Hole	825.75	lbs/hole	Chemgold
	Tons Used/Unit Time	5,475.00	tons/time	Calc. - holes blasted/time / lbs/hole
	Emission control factor (ECF)	0%	(Uncontrolled)	Chemgold
1.014	***Wind Erosion (Waste Rock Stockpile)***			
	Size of Active Waste Rock Stockpile	40	acres	Chemgold
	Emission control factor (ECF)	0%	(Uncontrolled)	Chemgold
1.015	***Wind Erosion (Soil Stockpiles)***			
	Size of Active Soil Stockpile	10	acres	Chemgold
	Emission control factor (ECF)	0%	(Uncontrolled)	Chemgold

Imperial Project
Air Pollutant Emission Inventory - Annual Operations
Project Variables - Unit Specific

	Factor	Value	Units	Source
1.016	***Haul Truck (Combustion)***			
	Availability of Individual Units	85%		Chemgold
	Utilization of Individual Units	87%		Chemgold
	Individual Unit Hours Used/Unit Time	6,500.00	hrs/time	Calc. - Avail. * Util. * hrs/time (Proj. Inf.)
	Individual Unit Fuel Consumption/Hour	0.044	1000 gal/hr	Chemgold
	No. Units	8	Units	Chemgold
	Total Fuel Consumption/Unit Time	2,288.00	1000 gal/time	Calc. - fuel use/hr * units * hrs/time
	Emission control factor (ECF)	0%	(Uncontrolled)	Chemgold
1.017	***Mine Dozer (Combustion)***			
	Availability of Individual Units	97.0%		Chemgold
	Utilization of Individual Units	92%		Chemgold
	Individual Unit Hours Used/Unit Time	7,817	hrs/time	Calc. - Avail. * Util. * hrs/time (Proj. Inf.)
	Individual Unit Fuel Consumption/Hour	0.02	1000 gal/hr	Chemgold
	No. Units	1	Unit	Chemgold
	Total Fuel Consumption/Unit Time	156.35	1000 gal/time	Calc. - fuel use/hr * units * hrs/time
	Emission control factor (ECF)	0%	(Uncontrolled)	Chemgold
1.018	***Drill Rig (Combustion)***			
	Hours/Hole Drilled	0.67	hours/hole	Chemgold
	Hours/Unit Time	8,884.65	hours/time	Calc. - holes/time (Proj. Inf.) * hrs/hole
	Fuel Consumption/hour	20	gal/hr	Chemgold
	Fuel Consumption/Unit Time	177,693	gal/time	Calc. - hrs/time * gal/time
	Emission control factor (ECF)	0%	(Uncontrolled)	Chemgold
1.019	***Loader (Combustion)***			
	Availability of Individual Units	85%		Chemgold
	Utilization of Individual Units	55%		Chemgold
	Individual Unit Hours Used/Unit Time	4,095	hrs/time	Calc. - Avail. * Util. * hrs/time (Proj. Inf.)
	Individual Unit Fuel Consumption/Hour	0.048	1000 gal/hr	Chemgold
	No. Units	1	Unit	Chemgold
	Total Fuel Consumption/Unit Time	196.57	1000 gal/time	Calc. - fuel use/hr * units * hrs/time
	Emission control factor (ECF)	0%	(Uncontrolled)	Chemgold
1.020	***Clean-Up Loader (Combustion)***			
	Availability of Individual Units	85%		Chemgold
	Utilization of Individual Units	25%		Chemgold
	Individual Unit Hours Used/Unit Time	1,862	hrs/time	Calc. - Avail. * Util. * hrs/time (Proj. Inf.)
	Individual Unit Fuel Consumption/Hour	0.028	1000 gal/hr	Chemgold
	No. Units	1	Unit	Chemgold
	Total Fuel Consumption/Unit Time	52.12	1000 gal/time	Calc. - fuel use/hr * units * hrs/time
	Emission control factor (ECF)	0%	(Uncontrolled)	Chemgold

Imperial Project
Air Pollutant Emission Inventory - Annual Operations
Project Variables - Unit Specific

	Factor	Value	Units	Source
Emission Unit Group 2: Heap Leaching Activity				
2.001	***Portable R-O-M Lime Silo Loading***			
	Silo Capacity	500	tons	Chemgold
	Tons/Delivery	25	tons/delivery	Chemgold
	Deliveries/Unit Time	438.00	deliveries/time	Calc. - tons/time (2.003) / tons/delivery
	Tons/Unit Time	10,950.00	tons/time	Calc. - tons/delivery * del./time
	Emission control factor (ECF)	99%	(Baghouse)	Chemgold
2.002	***Portable R-O-M Lime Hopper Loading***			
	Tons/Unit Time	10,950.00	tons/time	See 2.003 Lime Application to Ore
	Emission control factor (ECF)	0%	(Uncontrolled)	Chemgold
2.003	***Lime Application to Ore***			
	Tons/Load of Ore	0.24	tons/load	Chemgold
	Loads of Ore/Unit Time	45,625.00	loads/time	See 1.008B Ore Hauling
	Tons of Lime Used/Unit Time	10,950.00	tons/time	Calc. - tons/load * loads/time
	Emission Control Factor (ECF)	70%	(Water Sprays)	Chemgold
2.004	***Ore Ripping/Spreading/Dozing***			
	Hours Dozing/Unit Time	7,817	hours/time	See 2.006 Heap Leach Dozer (Comb.)
	Emission Control Factor (ECF)	0%	(Uncontrolled)	Chemgold
2.005	***Grader (Combustion)***			
	Availability of Individual Units	85%		Chemgold
	Utilization of Individual Units	90%		Chemgold
	Individual Unit Hours Used/Unit Time	6,701	hrs/time	Calc. - Avail. * Util. * hrs/time (Proj. Inf.)
	Individual Unit Fuel Consumption/Hour	0.01	1000 gal/hr	Chemgold
	No. Units	1	Unit	Chemgold
	Total Fuel Consumption/Unit Time	67.01	1000 gal/time	Calc. - fuel use/hr * units * hrs/time
	Emission control factor (ECF)	0%	(Uncontrolled)	Chemgold
2.006	***Heap Leach Dozer (Combustion)***			
	Availability of Individual Units	97.0%		Chemgold
	Utilization of Individual Units	92%		Chemgold
	Individual Unit Hours Used/Unit Time	7,817	hrs/time	Calc. - Avail. * Util. * hrs/time (Proj. Inf.)
	Individual Unit Fuel Consumption/Hour	0.02	1000 gal/hr	Chemgold
	No. Units	1	Unit	Chemgold
	Total Fuel Consumption/Unit Time	156.35	1000 gal/time	Calc. - fuel use/hr * units * hrs/time
	Emission control factor (ECF)	0%	(Uncontrolled)	Chemgold

Imperial Project
Air Pollutant Emission Inventory - Annual Operations
Project Variables - Unit Specific

	Factor	Value	Units	Source
2.007	***Cyanide Application and Leaching***			
2.010	***Wind Erosion (Heap Leach Pad) - Non-Leach***			
2.011	***Wind Erosion (Heap Leach Pad) - Leach***			
	Size of Heap	329	Acres (Max. Size of Heap)	Chemgold
	Area of Heap Under Leach	20.4	Acres	Chemgold
	Area of Fresh Ore Not Under Leach	20.4	Acres	Chemgold
	Years/Unit Time	1	yr/time	Calc. - Days/time (Proj. Info.) / 365
	Non-Leach Area Emission Control Factor (ECF_{Non})	0%	(Uncontrolled)	Chemgold
	Leachate Emission Control Factor (ECF_{Leach})	95%	(Heap Under Leach)	Mesquite Landfill EIS
	HCN Emission Control Factor (ECF_{HCN})	0%	(Uncontrolled)	Chemgold
2.008	***Pregnant Solution Pond***			
	Surface Area of Pond	54,400	sq. ft.	Chemgold
	Average pH of Pond	10.6		Chemgold
	NaCN Conc. in Pond	25	ppm	Chemgold
	Imperial Soln. Temp.	30	C	Chemgold
	Imperial Soln. Vapor Pressure	796	mmHg	Calc. - Vapor Press. of HCN @ Temp.
	Imperial Soln. Conc.	13.27	ppm (as CN)	Calc. - CN Conc. at NaCN Soln. Conc.
	Imperial HCN Conc.	4.00%	HCN Conc.	Calc. - Volatilization Curve (Domes)
	Days/Unit Time	365	da/time	Project Information
	Emission Control Factor (ECF)	0%	(Uncontrolled)	Chemgold
2.009	***Barren Solution Pond***			
	Surface Area of Pond	54,400	sq. ft.	Chemgold
	Average pH of Pond	10.6		Chemgold
	NaCN Conc. in Pond	25	ppm	Chemgold
	Imperial Soln. Temp.	28.9	C	Chemgold
	Imperial Soln. Vapor Pressure	795	mmHg	Calc. - Vapor Press. of HCN @ Temp.
	Imperial Soln. Conc.	13.27	ppm (as CN)	Calc. - CN Conc. at NaCN Soln. Conc.
	Imperial HCN Conc.	5.00%	HCN Conc.	Calc. - Volatilization Curve (Domes)
	Days/Unit Time	365	da/time	Project Information
	Emission Control Factor (ECF)	0%	(Uncontrolled)	Chemgold
Emission Unit Group 3: Process Plant				
3.001-5	***Carbon Adsorption Tanks 1-5***			
	No. Units	5	Units	Chemgold
	Surface Area of Pond	100	sq. ft.	Chemgold
	Average pH of Pond	10.6		Chemgold
	NaCN Conc. in Pond	25	ppm	Chemgold
	Imperial Soln. Temp.	30	C	Chemgold
	Imperial Soln. Vapor Pressure	796	mmHg	Calc. - Vapor Press. of HCN @ Temp.
	Imperial Soln. Conc.	13.27	ppm (as CN)	Calc. - CN Conc. at NaCN Soln. Conc.
	Imperial HCN Conc.	4.00%	HCN Conc.	Calc. - Volatilization Curve (Domes)
	Days/Unit Time	365	da/time	Project Information
	Emission Control Factor (ECF)	0%	(Uncontrolled)	Chemgold

Imperial Project
Air Pollution Emission Inventory
Project Variables - Unit Specific

	Factor	Value	Units	Source
3.006	***Acid Wash Tank***			
	Acid strength (%)	5%		Chemgold
	Specific Gravity of HCl	1.16		CRC Handbook
	Weight of H_2O	8.345	#/gal	CRC Handbook
	Consumption - Gal/Month	6,083	gal/mo	Chemgold
	Consumption - Gal/Unit Time	72,996	gal/time	Calc. - gal/mo * mo/time
	Consumption - Lbs/Unit Time	706,616	lbs/time	Calc. - gal/time * #/gal * Spec. Grav.
	Emission control factor (ECF)	0%	(Uncontrolled)	Chemgold
3.007	***Cyanide Make-up Tank***			
	Surface Area of Pond	113	sq. ft.	Chemgold
	Average pH of Pond	12		Chemgold
	NaCN Conc. in Pond	240,000.00	ppm	Chemgold
	Imperial Soln. Temp.	28.9	C	Chemgold
	Imperial Soln. Vapor Pressure	795	mmHg	Calc. - Vapor Press. of HCN @ Temp.
	Imperial Soln. Conc.	127,346.94	ppm (as CN)	Calc. - CN Conc. at NaCN Soln. Conc.
	Imperial HCN Conc.	0.00%	HCN Conc.	Calc. - Volatilization Curve (Domes)
	Days/Unit Time	365	days/time	Project Information
	Emission Control Factor (ECF)	0%	(Uncontrolled)	Chemgold
3.008	***Strip Tank***			
	Surface Area of Pond	38.50	sq. ft.	Chemgold
	Average pH of Pond	13.5		Chemgold
	NaCN Conc. in Pond	2,000.00	ppm	Chemgold
	Imperial Soln. Temp.	30	C	Chemgold
	Imperial Soln. Vapor Pressure	800	mmHg	Calc. - Vapor Press. of HCN @ Temp.
	Imperial Soln. Conc.	1061.22	ppm (as CN)	Calc. - CN Conc. at NaCN Soln. Conc.
	Imperial HCN Conc.	0.00%	HCN Conc.	Calc. - Volatilization Curve (Domes)
	Days/Year Under Leach	365	da/yr	Project Information
	Emission Control Factor (ECF)	0%	(Uncontrolled)	Chemgold
3.009	***Electrowinning Cell***			
	Surface Area of Pond	24.00	sq. ft.	Chemgold
	Average pH of Pond	13.5		Chemgold
	NaCN Conc. in Pond	250	ppm	Chemgold
	Imperial Soln. Temp.	369.3	C	Chemgold
	Imperial Soln. Vapor Pressure	825	mmHg	Calc. - Vapor Press. of HCN @ Temp.
	Imperial Soln. Conc.	132.65	ppm (as CN)	Calc. - CN Conc. at NaCN Soln. Conc.
	Imperial HCN Conc.	0.00%	HCN Conc.	Calc. - Volatilization Curve (Domes)
	Days/Unit Time	365	days/time	Project Information
	Emission Control Factor (ECF)	0%	(Uncontrolled)	Chemgold

Imperial Project
Air Pollution Emission Inventory
Project Variables - Unit Specific

	Factor	Value	Units	Source
Emission Unit Group 4: Refining				
4.001	***Mercury Retort Furnace (Electric)***			
	Utilization of Individual Units	25%		Chemgold
	Individual Unit Hours Used/Unit Time	2,190	hrs/time	Calc. - Util. * hrs/time (Proj. Inf.)
	No. Units	1	Unit	Chemgold
	Emission control factor (ECF)	0%	(Uncontrolled)	Chemgold
	Mercury Emissions in grams/hour	1.87E-03	g/hr	Chemgold
	Mercury Emissions in pounds/hour	4.13E-06	lbs/hr	Calc. - g/hr to lbs/hr conversion
Emission Unit Group 5: Laboratory				
5.001	***Jaw Crusher***			
	Hours/Unit Time	2,080	hrs/time	Chemgold
	Tons/Hour	0.23	tph	Chemgold
	Tons Processed/Unit Time	478.4	tons/time	Calc. - tph * hrs/time
	Emission control factor (ECF)	0%	(Uncontrolled)	Chemgold
5.002	***Pulverizer***			
	Hours/Unit Time	2,080	hrs/time	Chemgold
	Tons/Hour	0.23	tph	Chemgold
	Tons Processed/Unit Time	478.4	tons/time	Calc. - tph * hrs/time
	Emission control factor (ECF)	0%	(Uncontrolled)	Chemgold
5.003	***Fume Hood***			
	Surface Area of Pond	0.79	sq. ft.	Chemgold
	Average pH of Pond	12		Chemgold
	NaCN Conc. in Pond	240,000.00	ppm	Chemgold
	Imperial Soln. Temp.	12	C	Chemgold
	Imperial Soln. Vapor Pressure	790	mmHg	Calc. - Vapor Press. of HCN @ Temp.
	Imperial Soln. Conc.	127,346.94	ppm (as CN)	Calc. - CN Conc. at NaCN Soln. Conc.
	Imperial HCN Conc.	0.00%	HCN Conc.	Calc. - Volatilization Curve (Domes)
	Days/Unit Time	365	days/time	Project Information
	Emission Control Factor (ECF)	0%	(Uncontrolled)	Chemgold
5.004	***Waste Acid Tank***			
	Emissions calculated as part of Emission Unit No. 3.006			
Emission Unit Group 6: Shop Area				
6.001	***Main Diesel Tank 1***			
	Tank Height (Vertical Tank)	20	ft	Chemgold
	Tank Diameter (Vertical Tank)	19	ft	Chemgold
	Liquid Height (Vertical Tank)	19	ft	Chemgold
	Avg. Liquid Height (Vertical Tank)	15	ft	Chemgold
	Working Volume	40,000	gal	Chemgold
	Turnovers/yr	100	turnovers/yr	Calc. - Throughput / tank size
	Throughput	4,016,000	gal/yr	Chemgold
	Standing Losses	7.04	lbs/yr (VOCs)	Calc. - EPA Tanks
	Working Losses	63.85	lbs/yr (VOCs)	Calc. - EPA Tanks
	Total Losses	70.89	lbs/yr (VOCs)	Calc. - EPA Tanks

Imperial Project
Air Pollutant Emission Inventory - Annual Operations
Project Variables - Unit Specific

	Factor	Value	Units	Source
6.002	***Street Diesel Tank***			
	Tank Height (Vertical Tank)	10	ft	Chemgold
	Tank Diameter (Vertical Tank)	6	ft	Chemgold
	Liquid Height (Vertical Tank)	10	ft	Chemgold
	Avg. Liquid Height (Vertical Tank)	8	ft	Chemgold
	Working Volume	2,000	gal	Chemgold
	Turnovers/yr	55	turnovers/yr	Calc. - Throughput / tank size
	Throughput	109,600	gal/yr	Chemgold
	Standing Losses	0.28	lbs/yr (VOCs)	Calc. - EPA Tanks
	Working Losses	2.78	lbs/yr (VOCs)	Calc. - EPA Tanks
	Total Losses	3.06	lbs/yr (VOCs)	Calc. - EPA Tanks
6.003	***Unleaded Gasoline Tank***			
	Tank Height (Vertical Tank)	10	ft	Chemgold
	Tank Diameter (Vertical Tank)	6	ft	Chemgold
	Liquid Height (Vertical Tank)	10	ft	Chemgold
	Avg. Liquid Height (Vertical Tank)	7	ft	Chemgold
	Working Volume	2,000	gal	Chemgold
	Turnovers/yr	21	turnovers/yr	Calc. - Throughput / tank size
	Throughput	41,200	gal/yr	Chemgold
	Standing Losses	625.94	lbs/yr (VOCs)	Calc. - EPA Tanks
	Working Losses	563.29	lbs/yr (VOCs)	Calc. - EPA Tanks
	Total Losses	1,189.23	lbs/yr (VOCs)	Calc. - EPA Tanks
6.004	***Coolant Tank***			
	Shell Length (Horizontal Tank)	14	ft	Chemgold
	Tank Diameter (Horizontal Tank)	7	ft	Chemgold
	Working Volume	5,000	gal	Chemgold
	Turnovers/yr	1	turnovers/yr	Calc. - Throughput / tank size
	Throughput	5,000.00	gal/yr	Chemgold
	Standing Losses	0.18	lbs/yr (VOCs)	Calc. - EPA Tanks
	Working Losses	0.02	lbs/yr (VOCs)	Calc. - EPA Tanks
	Total Losses	0.20	lbs/yr (VOCs)	Calc. - EPA Tanks
	% Ethylene Glycol in Fluid	95%		Chemgold
Emission Unit Group 7: Mine & Process Area Support Activities				
7.001	***Water Truck (Combustion)***			
	Availability of Individual Units	85%		Chemgold
	Utilization of Individual Units	45%		Chemgold
	Individual Unit Hours Used/Unit Time	3,351	hrs/time	Calc. - Avail. * Util. * hrs/time (Proj. Inf.)
	Individual Unit Fuel Consumption/Hour	0.019	1000 gal/hr	Chemgold
	No. Units	2	Units	Chemgold
	Total Fuel Consumption/Unit Time	127.33	1000 gal/time	Calc. - fuel use/hr * units * hrs/time
	Emission control factor (ECF)	0%	(Uncontrolled)	Chemgold

Imperial Project
Air Pollutant Emission Inventory - Annual Operations
Project Variables - Unit Specific

	Factor	Value	Units	Source
7.002	***Water Truck Traffic***			
	Mean Vehicle Speed (S)	10	MPH	Chemgold
	Mean Vehicle Weight (W)	35	tons	Chemgold
	Mean Number of Wheels (w)	6	wheels	Chemgold
	Vehicle Miles Traveled/Trip	10.00	VMT	Chemgold
	Trips/Unit Time	708	trips/time	Chemgold
	Vehivle Miles Traveled/Unit Time	7,080	VMT/Unit Time	Calc. - VMT * trips/time
	Emission Control Factor (ECF)	95%	(Watering)	Chemgold
7.003	***Backup Diesel-Fueled Generator***			
	Engine Rating	750	hp	Calculated
	Engine Rating	500	kW	Chemgold
	Hours/Unit Time	200	hrs/time	Calc. - Avail. * Util. * hrs/time (Proj. Inf.)
	Fuel Consumption/Hour	9.2	gal/hr	Chemgold
	No. Units	1	units	Chemgold
	Fuel Consumption/Unit Time	1,840	gal/time	Calc. - fuel use/hr * units * hrs/time
	Emission control factor (ECF)	0%	(Uncontrolled)	Chemgold
Emission Unit Group 8: Other Mobile Emission Units				
8.001	***On-Site Delivery Truck Traffic***			
	Mean Vehicle Speed (S)	25	MPH	Chemgold
	Mean Vehicle Weight (W)	35	tons	Chemgold
	Mean Number of Wheels (w)	18	wheels	Chemgold
	Vehicle Miles Traveled/Trip	0.98	VMT	Chemgold
	Trips/Unit Time	1,460	trips/time	Chemgold
	Vehicle Miles Traveled/Unit Time	1,431	VMT/Unit Time	Calc. - VMT * trips/time
	Emission Control Factor (ECF)	90%	(Watering)	Chemgold
8.002	***On-Site Light Vehicle Traffic***			
	Mean Vehicle Speed (S)	25	MPH	Chemgold
	Mean Vehicle Weight (W)	7.2	tons	Chemgold
	Mean Number of Wheels (w)	5.08	wheels	Chemgold
	Vehicle Miles Traveled/Trip	1.5	VMT	Chemgold
	Trips/Unit Time	53,655	trips/time	Chemgold
	Vehivle Miles Traveled/Unit Time	80,483	VMT/Unit Time	Calc. - VMT * trips/time
	Emission Control Factor (ECF)	90%	(Watering)	Chemgold
8.003	***Off-Site Delivery Truck Traffic***			
	Mean Vehicle Speed (S)	35	MPH	Chemgold
	Mean Vehicle Weight (W)	35	tons	Chemgold
	Mean Number of Wheels (w)	18	wheels	Chemgold
	Vehicle Miles Traveled/Trip	8.33	VMT	Chemgold
	Trips/Unit Time	1,460	trips/time	Chemgold
	Vehivle Miles Traveled/Unit Time	12,162	VMT/Unit Time	Calc. - VMT * trips/time
	Emission Control Factor (ECF)	80%	(Chemical Treatment)	Chemgold

Imperial Project
Air Pollutant Emission Inventory - Annual Operations
Project Variables - Unit Specific

	Factor	Value	Units	Source
8.004	***Off-Site Light Vehicle Traffic***			
	Mean Vehicle Speed (S)	35	MPH	Chemgold
	Mean Vehicle Weight (W)	7.2	tons	Chemgold
	Mean Number of Wheels (w)	4	wheels	Chemgold
	Vehicle Miles Traveled/Trip	8.33	VMT	Chemgold
	Trips/Unit Time	56,575	trips/time	Chemgold
	Vehivle Miles Traveled/Unit Time	471,270	VMT/Unit Time	Calc. - VMT * trips/time
	Emission Control Factor (ECF)	80%	(Chemical Treatment)	Chemgold

Metals Analysis

Ore-Based HAPs Emissions

Hazardous Air Pollutant	Analytical Results (ppm)	Calculated Emission Factor (lbs/lb)	Hazardous Air Pollutant	Analytical Results (ppm)	Calculated Emission Factor (lbs/lb)
Antimony (Sb)	32.80	3.28E-05	Lead (Pb)	13.25	1.33E-05
Arsenic (As)	179.75	1.80E-04	Manganese (Mn)	777.25	7.77E-04
Beryllium (Be)	2.00	2.00E-06	Mercury (Hg)	0.40	4.01E-07
Cadmium (Cd)	5.50	5.50E-06	Nickel (Ni)	25.00	2.50E-05
Chromium (Cr)	80.00	8.00E-05	Selenium (Se)	5.00	5.00E-06
Cobalt (Co)	11.50	1.15E-05			

Waste-Based HAPs Emissions

Hazardous Air Pollutant	Analytical Results (ppm)	Calculated Emission Factor (lbs/lb)	Hazardous Air Pollutant	Analytical Results (ppm)	Calculated Emission Factor (lbs/lb)
Antimony (Sb)	13.16	1.32E-05	Lead (Pb)	5.00	5.00E-06
Arsenic (As)	59.33	5.93E-05	Manganese (Mn)	607.67	6.08E-04
Beryllium (Be)	2.00	2.00E-06	Mercury (Hg)	0.40	3.97E-07
Cadmium (Cd)	5.00	5.00E-06	Nickel (Ni)	20.00	2.00E-05
Chromium (Cr)	109.00	1.09E-04	Selenium (Se)	5.00	5.00E-06
Cobalt (Co)	13.67	1.37E-05			

(Source: Bondar-Clegg Geotechnical Lab Report, 1995)

This page intentionally left blank
for reproduction purposes.

APPENDIX D

EMISSION CALCULATIONS - MAXIMUM 24-HOUR OPERATIONS

Calculations - 24-Hr Operations

Drilling Sources

(Emission Factor Source: AP-42 (5th Ed.) Table 11.9-4 (Overburden Drilling))

EF_{TSP} = 1.30 lbs/hole

$EF_{PM10} = 0.5 * EF_{TSP}$ = 0.65 lbs/hole (assumption)

Emission Unit		lbs/hole		Holes/time	Emission Controls		Controlled Emission (lbs/time)			
		EF_{TSP}	EF_{PM10}		ECF	Technology	TSP	PM_{10}	Sb	As
1.001	Drilling - Waste Rock	1.30	0.65	27	85%	(H_20 Shroud)	5.27E+00	2.63E+00	6.93E-05	3.12E-04
1.002	Drilling - Ore	1.30	0.65	9	85%	(H_20 Shroud)	1.76E+00	8.78E-01	5.76E-05	3.15E-04

Emission Unit		Controlled Emission (lbs/time)								
		Be	Cd	Cr	Co	Pb	Mn	Hg	Ni	Se
1.001	Drilling - Waste Rock	1.05E-05	2.63E-05	5.74E-04	7.20E-05	2.63E-05	3.20E-03	2.09E-06	1.05E-04	2.63E-05
1.002	Drilling - Ore	3.51E-06	9.65E-06	1.40E-04	2.02E-05	2.33E-05	1.36E-03	7.04E-07	4.39E-05	8.78E-06

Calculations - 24-Hr Operations

Blasting Sources

(Emission Factor Source: Wyoming Department of Environmental Quality, Air Quality Division (1/24/79 Memorandum regarding Emission Factors for Open-Pit (Coal) Mines))

Emission Factor Calculation

EF_{TSP} = 50.00 lbs/blast

$EF_{PM10} = 0.5 \times EF_{TSP}$ = 25.00 lbs/blast (Assumption)

Emission Unit		lbs/blast		Blasts/time	Emission Controls		Cntrld Emission (lbs/time)	
		EF_{TSP}	EF_{PM10}		ECF	Technology	TSP	PM10
1.003	Blasting - Waste Rock	50	25.00	1.00	0%	(Uncontrolled)	5.00E+01	2.50E+01
1.004	Blasting - Ore	50	25.00	0.00	0%	(Uncontrolled)	0.00E+00	0.00E+00

Emission Unit		Controlled Emissions (lbs/time)							
		Sb	As	Be	Cd	Cr	Co	Pb	Mn
1.003	Blasting - Waste Rock	6.58E-04	2.97E-03	1.00E-04	2.50E-04	5.45E-03	6.84E-04	2.50E-04	3.04E-02
1.004	Blasting - Ore	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Emission Unit		Controlled Emissions (lbs/time)		
		Hg	Ni	Se
1.003	Blasting - Waste Rock	1.99E-05	1.00E-03	2.50E-04
1.004	Blasting - Ore	0.00E+00	0.00E+00	0.00E+00

Drop Point Sources

(Emission Factor Source: AP-42 (5th Ed.) §13.2.4 - Aggregate Handling and Storage Piles)

EF_{TSP} (lbs/ton) = K x (0.0032) x {[(U/5)^1.3]/[(M/2)^1.4]}

EF_{PM10} (lbs/ton) = K x (0.0032) x {[(U/5)^1.3]/[(M/2)^1.4]}

Where:

K = Particle Size Multiplier (dimensionless)

U = Mean Wind Speed (MPH)

M = Material Moisture Content

Emission Unit		Mean Wind Speed	Mat. Moisture Content	Emission Factors		tons/time	Emission Controls	
				EF_{TSP}	EF_{PM10}		ECF	Technology
1.005	Waste Rock Loading	3.0	3.67	0.0005	0.0002	9.75E+04	0%	(Uncontrolled)
1.006	Ore Loading	3.0	3.67	0.0005	0.0002	3.25E+04	0%	(Uncontrolled)
1.007	Waste Rock Dumping	6.0	3.67	0.0013	0.0006	9.75E+04	0%	(Uncontrolled)
1.008	Ore Dumping	6.0	3.67	0.0013	0.0006	3.25E+04	0%	(Uncontrolled)
2.003	Lime Application to Ore	6.0	1.00	0.0079	0.0037	32.50	70%	(Water Sprays)

Emission Unit		Controlled Emission (lbs/time)						
		TSP	PM_{10}	Sb	As	Be	Cd	Cr
1.005	Waste Rock Loading	5.08E+01	2.40E+01	6.69E-04	3.01E-03	1.02E-04	2.54E-04	5.54E-03
1.006	Ore Loading	1.69E+01	8.01E+00	5.55E-04	3.04E-03	3.39E-05	9.31E-05	1.35E-03
1.007	Waste Rock Dumping	1.25E+02	5.92E+01	1.65E-03	7.42E-03	2.50E-04	6.25E-04	1.36E-02
1.008	Ore Dumping	4.17E+01	1.97E+01	1.37E-03	7.50E-03	8.34E-05	2.29E-04	3.34E-03
2.003	Lime Application to Ore	7.72E-02	3.65E-02	n/a	n/a	n/a	n/a	n/a

Emission Unit		Controlled Emission (lbs/time)					
		Co	Pb	Mn	Hg	Ni	Se
1.005	Waste Rock Loading	6.94E-04	2.54E-04	3.09E-02	2.02E-05	1.02E-03	2.54E-04
1.006	Ore Loading	1.95E-04	2.24E-04	1.32E-02	6.79E-06	4.23E-04	8.47E-05
1.007	Waste Rock Dumping	1.71E-03	6.25E-04	7.60E-02	4.97E-05	2.50E-03	6.25E-04
1.008	Ore Dumping	4.80E-04	5.52E-04	3.24E-02	1.67E-05	1.04E-03	2.08E-04
2.003	Lime Application to Ore	n/a	n/a	n/a	n/a	n/a	n/a

Dozing/Ripping/Spreading

(Source: AP-42 (5th Ed.) Table 11.9-4 (Overburden Dozing))

EF_{TSP} (lbs/hr) = (5.7(s)^1.2) / (M^1.3)

EF_{PM10} (lbs/hr) = 0.75 * {(1.0(s)^1.5)/M^1.4)}

s = Material silt content

M = Material Moisture Content

Emission Unit		Silt Content	Moisture Content	(lbs/hr)		hrs/time	Emission Controls	
				EF_{TSP}	EF_{PM10}		ECF	Technology
1.009	Waste Rock Dozing	1.40	3.67	1.57E+00	2.01E-01	21.42	0%	(Uncontrolled)
2.004	Ore Ripping/Spreading/Dozing	1.26	3.67	1.39E+00	1.72E-01	21.42	0%	(Uncontrolled)

Emission Unit		Calculated Emissions (lbs/time)							
		TSP	PM10	Sb	As	Be	Cd	Cr	Co
1.009	Waste Rock Dozing	3.37E+01	4.31E+00	4.44E-04	2.00E-03	6.74E-05	1.69E-04	3.68E-03	4.61E-04
2.004	Ore Ripping/Spreading/Dozing	2.97E+01	3.68E+00	9.75E-04	5.34E-03	5.94E-05	1.63E-04	2.38E-03	3.42E-04

Emission Unit		Calculated Emissions (lbs/time)				
		Pb	Mn	Hg	Ni	Se
1.009	Waste Rock Dozing	1.69E-04	2.05E-02	1.34E-05	6.74E-04	1.69E-04
2.004	Ore Ripping/Spreading/Dozing	3.94E-04	2.31E-02	1.19E-05	7.43E-04	1.49E-04

Emissions from Unpaved Surfaces

(Emission Factor Source: Wyoming Department of Environmental Quality, Air Quality Division (1/24/79 Memorandum regarding Emission Factors for Open-Pit (Coal) Mines))

EF_{TSP} (lbs/VMT) = $0.81 \times (s) \times (S/30)^{n} \times (w/4) \times (0.62)$

EF_{PM10} (lbs/VMT) = EF_{TSP} x (0.30)

s =Silt content of road surface material
S = Mean vehicle speed
n = 2 If S < 30 MPH; 1 if S ≥ 30 MPH
w = Mean number of wheels (x 2 if oversize)
p = No. days with at least 0.01 in. of precipitation/year

Emission Unit		s	S	n	w	p	EF_{TSP}	EF_{PM10}	VMT/time
1.010	Waste Rock Hauling	1.26	22.90	2.00	12.00	0.00	1.11	0.33	869.38
1.011	Ore Hauling	1.26	22.90	2.00	12.00	0.00	1.11	0.33	289.79
7.002	Water Truck Traffic	1.26	10.00	2.00	6.00	0.00	0.11	0.03	20.00
8.001	On-Site Delivery Truck Traffic	1.26	25.00	2.00	18.00	0.00	1.98	0.59	3.92
8.002	On-Site Light Vehicle Traffic	1.26	25.00	2.00	5.08	0.00	0.56	0.17	220.50
8.003	Off-Site Delivery Truck Traffic	1.26	35.00	1.00	18.00	0.00	3.32	1.00	33.32
8.004	Off-Site Light Vehicle Traffic	1.26	35.00	1.00	4.00	0.00	0.74	0.22	1,291.15

Emission Unit		Emission Controls		Controlled Emissions (lbs/time)					
		ECF	Technology	TSP	PM10	Sb	As	Be	Cd
1.010	Waste Rock Hauling	90%	(Watering)	9.62E+01	2.88E+01	1.27E-03	5.71E-03	1.92E-04	4.81E-04
1.011	Ore Hauling	90%	(Watering)	3.21E+01	9.62E+00	4.22E-04	1.90E-03	6.41E-05	1.60E-04
7.002	Water Truck Traffic	95%	(Watering)	1.05E-01	3.16E-02	1.39E-06	6.26E-06	2.11E-07	5.27E-07
8.001	On-Site Delivery Truck Traffic	90%	(Watering)	7.75E-01	2.33E-01	1.02E-05	4.60E-05	1.55E-06	3.88E-06
8.002	On-Site Light Vehicle Traffic	90%	(Watering)	1.23E+01	3.69E+00	1.62E-04	7.30E-04	2.46E-05	6.15E-05
8.003	Off-Site Delivery Truck Traffic	80%	(Chemical Stabilizers)	2.21E+01	6.64E+00	2.91E-04	1.31E-03	4.43E-05	1.11E-04
8.004	Off-Site Light Vehicle Traffic	80%	(Chemical Stabilizers)	1.91E+02	5.72E+01	2.51E-03	1.13E-02	3.81E-04	9.53E-04

Emissions from Unpaved Surfaces (Continued)

Emission Unit		Controlled Emissions (lbs/time)						
		Cr	Co	Pb	Mn	Hg	Ni	Se
1.010	Waste Rock Hauling	1.05E-02	1.31E-03	4.81E-04	5.84E-02	3.82E-05	1.92E-03	4.81E-04
1.011	Ore Hauling	3.49E-03	4.38E-04	1.60E-04	1.95E-02	1.27E-05	6.41E-04	1.60E-04
7.002	Water Truck Traffic	1.15E-05	1.44E-06	5.27E-07	6.41E-05	4.19E-08	2.11E-06	5.27E-07
8.001	On-Site Delivery Truck Traffic	8.45E-05	1.06E-05	3.88E-06	4.71E-04	3.08E-07	1.55E-05	3.88E-06
8.002	On-Site Light Vehicle Traffic	1.34E-03	1.68E-04	6.15E-05	7.48E-03	4.89E-06	2.46E-04	6.15E-05
8.003	Off-Site Delivery Truck Traffic	2.41E-03	3.03E-04	1.11E-04	1.35E-02	8.79E-06	4.43E-04	1.11E-04
8.004	Off-Site Light Vehicle Traffic	2.08E-02	2.61E-03	9.53E-04	1.16E-01	7.57E-05	3.81E-03	9.53E-04

Ammonium Nitrate Silo Emissions - Loading/Unloading

(Source: AP-42 (5th Ed.) §8.2; Table 8.2-2 (Ammonium Nitrate Bulk Loading Operations)

EF_{TSP} = *0.02* lbs/ton

$EF_{PM10} = 0.5 * EF_{TSP}$ = *0.01* lbs/ton (assumption)

Emission Unit		(lbs/ton) EF_{TSP}	(lbs/ton) EF_{PM10}	tons/time	Emission Controls ECF	Emission Controls Technology	Calculated Emissions (lbs/time) TSP	Calculated Emissions (lbs/time) PM10
1.012	Ammonium Nitrate Prill Silo Loading	0.02	0.010	25.00	0%	(Uncontrolled)	5.00E-01	2.50E-01
1.013	Ammonium Nitrate Prill Silo Unloading	0.02	0.010	14.87	0%	(Uncontrolled)	2.97E-01	1.49E-01

Silo Emissions - Loading

(Source: AP-42 (5th Ed.) §11.12, Table 11.12-2: Cement Unloading to Elevated Storage Silo (Pneumatic)

EF_{TSP} = *0.2700* lbs/ton (TSP)

$EF_{PM10} = 0.5 * EF_{TSP}$ = *0.1350* lbs/ton (PM_{10}) (assumption)

Emission Unit		(lbs/ton) EF_{TSP}	(lbs/ton) EF_{PM10}	(tons/time)	Emission Controls ECF	Emission Controls Technology	Controlled Emissions (lbs/time) TSP	Controlled Emissions (lbs/time) PM10
2.001	Portable R-O-M Lime Silo Loading	0.2700	0.1350	50.00	99%	(Baghouse)	1.35E-01	6.75E-02

Silo Emissions - Loading

(Source: AP-42 (5th Ed.) §11.12, Table 11.12-2: Weigh Hopper Loading)

$EF_{TSP} = (EF_{PM10}) =$ *0.0200* lbs/ton (TSP) (assumption)

$EF_{PM10} =$ *0.0200* lbs/ton (PM_{10})

Emission Unit		(lbs/ton) EF_{TSP}	(lbs/ton) EF_{PM10}	(tons/time)	Emission Controls ECF	Emission Controls Technology	Controlled Emissions (lbs/time) TSP	Controlled Emissions (lbs/time) PM10
2.002	Portable R-O-M Lime Hopper Loading	0.0200	0.0200	32.50	0%	(Uncontrolled)	6.50E-01	6.50E-01

Wind Erosion

(Source: AP-42 (4th Ed.) §11.2.3 Aggregate Handling & Storage Piles)

EF_{TSP} (lbs/acre/day) = 1.7 x (s/5) x (f/15) x ((365-p)/235)

EF_{PM10} (lbs/acre/day) = EF_{TSP} x 0.5

s = Silt content of surface material

f = percentage of time that the unobstructed wind speed exceeds 5.4 m/s (12 MPH)

p = No. days/year with at least 0.01 in. of precipitation/year

Emission Unit		Emission Factor Variables s	f (%)	p (%)	(lb/acre/day) EF_{TSP}	(lb/acre/day) EF_{PM10}	Stockpile Size (Acres)
1.014	Wind Erosion (Waste Rock Stockpile)	1.40	9.10	0.00	0.45	0.22	40.00
1.015	Wind Erosion (Soil Stockpiles)	1.40	9.10	0.00	0.45	0.22	10.00
2.010	Wind Erosion (Heap Leach Pad) - Non-Leach	1.26	9.10	0.00	0.40	0.20	20.40
2.011	Wind Erosion (Heap Leach Pad) - Leach	1.26	9.10	0.00	0.40	0.20	20.40

Emission Unit		Day/Time	Emission Controls ECF	Emission Controls Technology	Controlled Emissions (lbs/time) TSP	Controlled Emissions (lbs/time) PM10	Sb
1.014	Wind Erosion (Waste Rock Stockpile)	1.00	0%	(Uncontrolled)	1.79E+01	8.97E+00	2.36E-04
1.015	Wind Erosion (Soil Stockpiles)	1.00	0%	(Uncontrolled)	4.49E+00	2.24E+00	5.90E-05
2.010	Wind Erosion (Heap Leach Pad) - Non-Leach	1.00	0%	(Uncontrolled)	8.23E+00	4.12E+00	2.70E-04
2.011	Wind Erosion (Heap Leach Pad) - Leach	1.00	95%	(Leachate)	4.12E-01	2.06E-01	1.35E-05

Emission Unit		Controlled Emissions (lbs/time) As	Be	Cd	Cr	Co	Pb
1.014	Wind Erosion (Waste Rock Stockpile)	1.06E-03	3.59E-05	8.97E-05	1.96E-03	2.45E-04	8.97E-05
1.015	Wind Erosion (Soil Stockpiles)	2.66E-04	8.97E-06	2.24E-05	4.89E-04	6.13E-05	2.24E-05
2.010	Wind Erosion (Heap Leach Pad) - Non-Leach	1.48E-03	1.65E-05	4.53E-05	6.59E-04	9.47E-05	1.09E-04
2.011	Wind Erosion (Heap Leach Pad) - Leach	7.40E-05	8.23E-07	2.26E-06	3.29E-05	4.74E-06	5.46E-06

Emission Unit		Controlled Emissions (lbs/time) Mn	Hg	Ni	Se
1.014	Wind Erosion (Waste Rock Stockpile)	1.09E-02	7.12E-06	3.59E-04	8.97E-05
1.015	Wind Erosion (Soil Stockpiles)	2.73E-03	1.78E-06	8.97E-05	2.24E-05
2.010	Wind Erosion (Heap Leach Pad) - Non-Leach	6.40E-03	3.30E-06	2.06E-04	4.12E-05
2.011	Wind Erosion (Heap Leach Pad) - Leach	3.20E-04	1.65E-07	1.03E-05	2.06E-06

Crushing Operations

(Source: AP-42 (5th Ed.) §11.24 - Metallic Mineral Processing (Low Moisture Ore)) - Split 65% Crushers/35% Screens per EPA Guidance

EF_{TSP} = *0.7800* lbs/ton (TSP)

EF_{PM10} = *0.0553* lbs/ton (PM_{10})

Emission Unit		(lbs/ton)		(tons/time)	Emission Controls		Controlled Emissions (lbs/time)		
		EF_{TSP}	EF_{PM10}		ECF	Technology	TSP	PM10	Sb
5.001	Jaw Crusher	0.7800	0.0553	1.31	0%	(Uncontrolled)	1.02E+00	7.24E-02	3.35E-05
5.002	Pulverizer	0.7800	0.0553	1.31	0%	(Uncontrolled)	1.02E+00	7.24E-02	3.35E-05

Emission Unit		Controlled Emissions (lbs/time)							
		As	Be	Cd	Cr	Co	Pb	Mn	Hg
5.001	Jaw Crusher	1.84E-04	2.04E-06	5.62E-06	8.18E-05	1.18E-05	1.35E-05	7.95E-04	4.10E-07
5.002	Pulverizer	1.84E-04	2.04E-06	5.62E-06	8.18E-05	1.18E-05	1.35E-05	7.95E-04	4.10E-07

Emission Unit		Cntrld Emissions (lbs/time)	
		Ni	Se
5.001	Jaw Crusher	2.56E-05	5.11E-06
5.002	Pulverizer	2.56E-05	5.11E-06

Mercury Retort Furnace Emissions

(Source: Chemgold Personnel)

Emission Unit		(lbs/hr)	hrs/time	Emission Controls		Ctrld Emissions (lbs/time)
		EF_{Hg}		ECF	Technology	Hg
4.001	Mercury Retort Furnace (Electric)	4.13E-06	6.00	0%	(Uncontrolled)	2.48E-05

Combustion Emissions - Large Stational Diesel Engines

(Source: AP-42 (5th Ed.) §3.4.2 - Large Uncontrolled Stationary I.C. Engines)

EF_{TSP} =	0.0697 lbs/mmBTU	$EF_{Benzene}$ =	7.06E-04 lbs/mmBTU
EF_{PM10} =	0.0573 lbs/mmBTU	$EF_{Toluene}$ =	2.81E-04 lbs/mmBTU
EF_{SOx} = 1.01 x S =	5.05E-02 lbs/mmBTU	$EF_{Xylenes}$=	1.93E-04 lbs/mmBTU
EF_{NOx} =	3.10E+00 lbs/mmBTU	$EF_{Formaldehyde}$ =	7.89E-05 lbs/mmBTU
EF_{CO} =	8.10E-01 lbs/mmBTU	$EF_{Acetaldehyde}$ =	2.52E-05 lbs/mmBTU
EF_{VOC} =	9.00E-02 lbs/mmBTU	$EF_{Acrolein}$ =	7.88E-06 lbs/mmBTU
		$EF_{Naphthalene}$ =	1.30E-04 lbs/mmBTU

Emission Unit		S	(gal/time)	(mmBTU/gal)	ECF	Technology	Controlled Emissions (lbs/time) TSP	PM10
7.003	Backup Diesel-Fueled Generator	0.05	-	0.133936	0%	(Uncontrolled)	0.00E+00	0.00E+00

Emission Unit		Controlled Emissions (lbs/time) SOx	NOx	CO	VOC/ROGs	Benzene	Toluene	Xylenes
7.003	Backup Diesel-Fueled Generator	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Emission Unit		Controlled Emissions (lbs/time) Formaldehyde	Acetaldehyde	Acrolein	Naphthalene
7.003	Backup Diesel-Fueled Generator	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Organic Liquid Storage Tanks - Diesel Storage

(Source: Leaking Underground Fuel Tank Field Manual, California State Water Resources Control Board, 1990.)

$EF_{Napthalene}$ =	0.13%	
$EF_{Cadmium}$ =	4.00E-02 ug/g =	4.00E-08 lbs/lb
$EF_{Chromium}$ =	3.60E-01 ug/g =	3.60E-07 lbs/lb
EF_{Cobalt} =	5.00E-02 ug/g =	5.00E-08 lbs/lb
EF_{Lead} =	1.00E-01 ug/g =	1.00E-07 lbs/lb
EF_{Nickel} =	5.00E-02 ug/g =	5.00E-08 lbs/lb
$EF_{Selenium}$ =	2.00E-02 ug/g =	2.00E-08 lbs/lb

(Source of VOC Emission Calcultations: AP-42 (5th Ed.) §7.1 - Liquid Organic Storage Tanks - Calculated Via US EPA Tanks Program (Vers. 2.0))

Emission Unit		Standing Losses lbs/time (VOCs)	Working Losses lbs/time (VOCs)	Controlled Emissions (lbs/time) VOCs	Napthalene	Cadmium	Chromium
6.001	Main Diesel Tank 1	0.02	0.17	1.94E-01	2.52E-04	7.77E-09	6.99E-08
line & Proce	0	0.00	0.01	8.38E-03	1.09E-05	3.35E-10	3.02E-09

Emission Unit		Controlled Emissions (lbs/time) Cobalt	Lead	Nickel	Selenium
6.001	Main Diesel Tank 1	9.71E-09	1.94E-08	9.71E-09	3.88E-09
Emission U	0	4.19E-10	8.38E-10	4.19E-10	1.68E-10

Organic Liquid Storage Tanks - Gasoline Storage

(Source: Leaking Underground Fuel Tank Field Manual, California State Water Resources Control Board, 1990.)

$EF_{Benzene}$ =	1.81%		
EF_{Hexane} =	1.87%		
$EF_{2,2,4\text{-}Trimethylpentane}$ =	2.45%		
$EF_{Xylenes}$ =	5.77%		
$EF_{Toluene}$ =	12.27%		
$EF_{Ethylbenzene}$ =	1.61%		
$EF_{Naphalene}$ =	0.29%		
$EF_{Bromine}$ =	2.13E+02 ug/g =	2.13E-04	lbs/lb
$EF_{Cadmium}$ =	4.00E-02 ug/g =	4.00E-08	lbs/lb
$EF_{Chlorine}$ =	1.90E+02 ug/g =	1.90E-04	lbs/lb
EF_{Lead} =	1.30E-02 g/g =	0-Jan-00	lbs/lb

(Source of VOC Emission Calcultations: AP-42 (5th Ed.) §7.1 - Liquid Organic Storage Tanks - Calculated Via US EPA Tanks Program (Vers. 2.0))

Emission Unit		Standing Losses lbs/time (VOCs)	Working Losses lbs/time (VOCs)	Controlled Emissions (lbs/time) VOCs	Benzene	Hexane
6.003	Unleaded Gasoline Tank	1.71	1.54	3.26E+00	5.90E-02	6.09E-02

Emission Unit		Controlled Emissions (lbs/yr) 2,2,4-Trimethylpentane	Xylenes	Toluene	Ethylbenzene	Napthalene
6.003	Unleaded Gasoline Tank	7.98E-02	1.88E-01	4.00E-01	5.25E-02	9.45E-03

Emission Unit		Controlled Emissions (lbs/yr) Bromine	Cadmium	Chlorine	Lead
6.003	Unleaded Gasoline Tank	6.92E-04	1.30E-07	6.19E-04	4.24E-02

Organic Liquid Storage Tanks - Ethylene Glycol

(Source of VOC Emission Calcultations: AP-42 (5th Ed.) §7.1 - Liquid Organic Storage Tanks - Calculated Via US EPA Tanks Program (Vers. 2.0))

Emission Unit		% of Ethylene Glycol in Soln.	Standing Losses lbs/time (VOCs)	Working Losses lbs/time (VOCs)	Controlled Emissions (lbs/time) VOCs	Ethylene Glycol
6.004	Coolant Tank	0.95	0.00	0.00	5.48E-04	5.21E-04

Acid Emissions - Hydrochloric Acid Storage/Use
(Source: Nevada Mining Association Data, 1995)

EF_{HCl} (lb/lb acid consumed) = 0.01 lb/lb (Acid Consumed) x Acid Strength (%) / 100

Emission Unit		Acid Strength	(lbs/lb) EF_{HCl}	lbs/time	Emission Controls ECF	Technology	Ctrld Emission (lbs/time) HCl
3.006	Acid Wash Tank	5%	0.0005	1,936	0%	(Uncontrolled)	9.68E-01
5.004	Waste Acid Tank	n/a[1]	n/a	n/a	n/a	n/a	n/a

[1] Emissions from Emission Unit 5.004 (Waste Acid Tank) included in emission calculations for Unit 3.006.

Hydrocyanic Acid Emissions from Open Top (Pond) Sources
(Emission Factor Source: Domes Study, 1980)

EF_{HCN} = 5.60E-05 lbs/ft2/da

HCN Emissions= Domes Emission (lb/ft2/da)xFactor(t)xFactor(pH)xFactor(c)x MWHCN/MWCN x Pond Size x da/yr x (100%-ECF)

Emission Unit		Exposed Suface Area (ft2)	Average pH of Pond	NaCN Conc. (ppm)	Soln. Temp. (C)	HCN VP (mmHg)	Emission Controls ECF	Technology
2.008	Pregnant Solution Pond	54,400.0	10.6	25.0	30	796	0.00%	(Uncontrolled)
2.009	Barren Solution Pond	54,400.0	10.6	25.0	29	795	0.00%	(Uncontrolled)
3.001	Carbon Adsorbtion Tank 1	100.0	10.6	25.0	30	796	0.00%	(Uncontrolled)
3.002	Carbon Adsorbtion Tank 2	100.0	10.6	25.0	30	796	0.00%	(Uncontrolled)
3.003	Carbon Adsorbtion Tank 3	100.0	10.6	25.0	30	796	0.00%	(Uncontrolled)
3.004	Carbon Adsorbtion Tank 4	100.0	10.6	25.0	30	796	0.00%	(Uncontrolled)
3.005	Carbon Adsorbtion Tank 5	100.0	10.6	25.0	30	796	0.00%	(Uncontrolled)
3.007	Cyanide Make-up Tank	113.0	12.0	240,000.0	29	795	0.00%	(Uncontrolled)
3.008	Strip Tank	38.5	13.5	2,000.0	30	800	0.00%	(Uncontrolled)
3.009	Electrowinning Cell	24.0	13.5	250.0	369	825	0.00%	(Uncontrolled)
5.003	Fume Hood	0.8	12.0	240,000.0	12	790	0.00%	(Uncontrolled)

Hydrocyanic Acid Emissions from Open Top (Pond) Sources - continued
(Emission Factor Source: Domes Study, 1980)

Emission Unit		Soln. Conc. ppm (as CN)	HCN Conc. @ pH	pH Factor	Vapor Press. Factor	Conc. Factor	days/time	lbs/time
2.008	Pregnant Solution Pond	13.27	4.00%	8.00	2.75	0.20	1	1.42E+01
2.009	Barren Solution Pond	13.27	4.00%	8.00	2.75	0.20	1	1.41E+01
3.001	Carbon Adsorbtion Tank 1	13.27	4.00%	8.00	2.75	0.20	1	2.60E-02
3.002	Carbon Adsorbtion Tank 2	13.27	4.00%	8.00	2.75	0.20	1	2.60E-02
3.003	Carbon Adsorbtion Tank 3	13.27	4.00%	8.00	2.75	0.20	1	2.60E-02
3.004	Carbon Adsorbtion Tank 4	13.27	4.00%	8.00	2.75	0.20	1	2.60E-02
3.005	Carbon Adsorbtion Tank 5	13.27	4.00%	8.00	2.75	0.20	1	2.60E-02
3.007	Cyanide Make-up Tank	127,346.94	0.00%	-	2.75	1,950.18	1	0.00E+00
3.008	Strip Tank	1,061.22	0.00%	-	2.77	16.25	1	0.00E+00
3.009	Electrowinning Cell	132.65	0.00%	-	2.85	2.03	1	0.00E+00
5.003	Fume Hood	127,346.94	0.00%	-	2.73	1,950.18	1	0.00E+00

Hydrocyanic Acid Emissions from Heap Leach Pads
(Emission Factor Source: Mesquite Mine AB2588 Air Toxic Inventory Report, Addendum - HCN Emissions from Heap Leaching Operations, 1991)

EF_{HCN} = 420.000 lbs/acre-yr

Emission Unit		Size of Heap Under Leach (Acres)	ECF	yrs/time	Controlled Emissions (lbs/time)
2.007	Cyanide Application and Leaching	20.40	0%	0.00	2.35E+01

Combustion - Mobile Sources (Haul Trucks)

(Source: AP-42 - Vol. 2 (Mobile) (4th Ed.) §II-7 - Heavy Duty Construction Equipment, Table II-7.1, Off-Highway Trucks)

EF_{TSP} = 17.70 lbs/1000 gal

$EF_{PM10} = EF_{TSP} \times 0.52$ = 9.20 lbs/1000 gal

EF_{SOx} = 31.20 lbs/1000 gal

EF_{NOx} = 286.10 lbs/1000 gal

EF_{CO} = 123.46 lbs/1000 gal

EF_{VOC} = 13.60 lbs/1000 gal

Emission Unit		(lbs/1000 gal)						(mgal/time)	ECF
		EF_{TSP}	EF_{PM10}	EF_{SOx}	EF_{NOx}	EF_{CO}	EF_{VOC}		
1.016	Haul Truck (Combustion)	17.70	9.20	31.20	286.10	123.46	13.60	6.25	0%

Emission Unit		Controlled Emissions (lbs/time)					
		TSP	PM10	SOx	NOx	CO	VOCs
1.016	Haul Truck (Combustion)	1.11E+02	5.75E+01	1.95E+02	1.79E+03	7.71E+02	8.50E+01

Combustion - Mobile Sources (Dozers)

(Source: AP-42 - Vol. 2 (Mobile) (4th Ed.) §II-7 - Heavy Duty Construction Equipment, Table II-7.1, Wheeled Dozer)

EF_{TSP} = 14.80 lbs/1000 gal

$EF_{PM10} = EF_{TSP} \times 0.52$ = 7.70 lbs/1000 gal

EF_{SOx} = 31.20 lbs/1000 gal

EF_{NOx} = 286.10 lbs/1000 gal

EF_{CO} = 123.46 lbs/1000 gal

EF_{VOC} = 13.60 lbs/1000 gal

Emission Unit		(lbs/1000 gal)						(mgal/time)	ECF
		EF_{TSP}	EF_{PM10}	EF_{SOx}	EF_{NOx}	EF_{CO}	EF_{VOC}		
1.017	Mine Dozer (Combustion)	14.80	7.70	31.20	286.10	123.46	13.60	0.43	0%
2.006	Heap Leach Dozer (Combustion)	14.80	7.70	31.20	286.10	123.46	13.60	0.43	0%

Emission Unit		Controlled Emissions (lbs/time)					
		TSP	PM10	SOx	NOx	CO	VOCs
1.017	Mine Dozer (Combustion)	6.34E+00	3.30E+00	1.34E+01	1.23E+02	5.29E+01	5.83E+00
2.006	Heap Leach Dozer (Combustion)	6.34E+00	3.30E+00	1.34E+01	1.23E+02	5.29E+01	5.83E+00

Combustion - Mobile Sources (Loaders)

(Source: AP-42 - Vol. 2 (Mobile) (4th Ed.) §II-7 - Heavy Duty Construction Equipment, Table II-7.1, Wheeled Loaders)

EF_{TSP} = 29.30 lbs/1000 gal

$EF_{PM10} = EF_{TSP} \times 0.52$ = 15.24 lbs/1000 gal

EF_{SOx} = 31.20 lbs/1000 gal

EF_{NOx} = 339.82 lbs/1000 gal

EF_{CO} = 98.66 lbs/1000 gal

EF_{VOC} = 43.16 lbs/1000 gal

Emission Unit		(lbs/1000 gal)						(mgal/time)	ECF
		EF_{TSP}	EF_{PM10}	EF_{SOx}	EF_{NOx}	EF_{CO}	EF_{VOC}		
1.019	Loader (Combustion)	29.30	15.24	31.20	339.82	98.66	43.16	0.54	0%
1.020	Clean-Up Loader (Combustion)	29.30	15.24	31.20	339.82	98.66	43.16	0.14	0%

Emission Unit		Controlled Emissions (lbs/time)					
		TSP	PM10	SOx	NOx	CO	VOCs
1.019	Loader (Combustion)	1.58E+01	8.21E+00	1.68E+01	1.83E+02	5.31E+01	2.32E+01
1.020	Clean-Up Loader (Combustion)	4.18E+00	2.18E+00	4.46E+00	4.85E+01	1.41E+01	6.16E+00

Combustion - Mobile Sources (Wheeled Graders)

(Source: AP-42 - Vol. 2 (Mobile) (4th Ed.) §II-7 - Heavy Duty Construction Equipment, Table II-7.1, Wheeled Graders)

EF_{TSP} = 22.20 lbs/1000 gal

$EF_{PM10} = EF_{TSP} \times 0.52$ = 11.54 lbs/1000 gal

EF_{SOx} = 31.20 lbs/1000 gal

EF_{NOx} = 253.84 lbs/1000 gal

EF_{CO} = 54.65 lbs/1000 gal

EF_{VOC} = 12.73 lbs/1000 gal

Emission Unit		(lbs/1000 gal)						(mgal/time)	ECF
		EF_{TSP}	EF_{PM10}	EF_{SOx}	EF_{NOx}	EF_{CO}	EF_{VOC}		
2.005	Grader (Combustion)	22.20	11.54	31.20	253.84	54.65	12.73	0.18	0%

Emission Unit		Controlled Emissions (lbs/time)					
		TSP	PM10	SOx	NOx	CO	VOCs
2.005	Grader (Combustion)	4.08E+00	2.12E+00	5.73E+00	4.66E+01	1.00E+01	2.34E+00

Combustion - Mobile Sources (Off-Highway Trucks)

(Source: AP-42 - Vol. 2 (Mobile) (4th Ed.) §II-7 - Heavy Duty Construction Equipment, Table II-7.1, Off-Highway Trucks)

EF_{TSP} = 17.70 lbs/1000 gal

$EF_{PM10} = EF_{TSP} \times 0.52$ = 9.20 lbs/1000 gal

EF_{SOx} = 31.20 lbs/1000 gal

EF_{NOx} = 286.10 lbs/1000 gal

EF_{CO} = 123.46 lbs/1000 gal

EF_{VOC} = 13.60 lbs/1000 gal

Emission Unit		(lbs/1000 gal)						(mgal/time)	ECF
		EF_{TSP}	EF_{PM10}	EF_{SOx}	EF_{NOx}	EF_{CO}	EF_{VOC}		
7.001	Water Truck (Combustion)	17.70	9.20	31.20	286.10	123.46	13.60	0.38	0%

Emission Unit		Controlled Emissions (lbs/time)					
		TSP	PM10	SOx	NOx	CO	VOCs
7.001	Water Truck (Combustion)	6.72E+00	3.50E+00	1.19E+01	1.09E+02	4.69E+01	5.17E+00

Combustion Emissions - Diesel and Gasoline Fueled Engines

(Source: AP-42 (5th Ed.) §3.3 - Gasoline and Diesel Fueled Industrial Engines)

EF_{TSP} = *0.5962* lbs/mmBTU

EF_{PM10} = *0.3100* lbs/mmBTU

EF_{SOx} = 0.29 lbs/mmBTU

EF_{NOx} = 4.41 lbs/mmBTU

EF_{CO} = 0.95 lbs/mmBTU

EF_{VOC} = 0.35 lbs/mmBTU

$EF_{Benzene}$ = 9.33E-04 lbs/mmBTU

$EF_{Toluene}$ = 4.89E-04 lbs/mmBTU

$EF_{Xylenes}$ = 2.85E-04 lbs/mmBTU

$EF_{Formaldehyde}$ = 1.18E-03 lbs/mmBTU

$EF_{Acetaldehyde}$ = 7.67E-04 lbs/mmBTU

$EF_{Acrolein}$ = 9.25E-05 lbs/mmBTU

$EF_{Naphthalene}$ = 8.48E-05 lbs/mmBTU

$EF_{Propylene}$ = 2.58E-03 lbs/mmBTU

$EF_{1,3\text{-}Butadiene}$ = 3.91E-05 lbs/mmBTU

Emission Unit		(gal/time)	(mmBTU/gal)	ECF	Ctrld Emiss. (lbs/time)			
					TSP	PM10	SOx	NOx
1.018	Drill Rig (Combustion)	480.00	0.133936	0%	3.83E+01	1.99E+01	1.86E+01	2.84E+02

Emission Unit		Controlled Emissions (lbs/time)						
		CO	VOC/ROGs	Benzene	Toluene	Xylenes	Formaldehyde	Acetaldehyde
1.018	Drill Rig (Combustion)	6.11E+01	2.25E+01	6.00E-02	3.14E-02	1.83E-02	7.59E-02	4.93E-02

Emission Unit		Controlled Emissions (lbs/time)			
		Acrolein	Naphthalene	Propylene	1,3-Butadiene
1.018	Drill Rig (Combustion)	5.95E-03	5.45E-03	1.66E-01	2.51E-03

This page intentionally left blank
for reproduction purposes.

APPENDIX E

EMISSION CALCULATIONS - ANNUAL OPERATIONS

Calculations - Annual Operations

Drilling Sources

(Emission Factor Source: AP-42 (5th Ed.) Table 11.9-4 (Overburden Drilling))

EF_{TSP} = 1.30 lbs/hole

EF_{PM10} * 0.5 = EF_{TSP} = 0.65 lbs/hole (assumption)

Emission Unit		lbs/hole EF_{TSP}	lbs/hole EF_{PM10}	Holes/time	Emission Controls ECF	Emission Controls Technology	Controlled Emission (lbs/time) TSP	PM_{10}	Sb	As
1.001	Drilling - Waste Rock	1.30	0.65	9,946	85%	(H_20 Shroud)	1.94E+03	9.70E+02	2.55E-02	1.15E-01
1.002	Drilling - Ore	1.30	0.65	3,315	85%	(H_20 Shroud)	6.46E+02	3.23E+02	2.12E-02	1.16E-01

Emission Unit		Controlled Emission (lbs/time) Be	Cd	Cr	Co	Pb	Mn	Hg	Ni	Se
1.001	Drilling - Waste Rock	3.88E-03	9.70E-03	2.11E-01	2.65E-02	9.70E-03	1.18E+00	7.70E-04	3.88E-02	9.70E-03
1.002	Drilling - Ore	1.29E-03	3.56E-03	5.17E-02	7.43E-03	8.57E-03	5.02E-01	2.59E-04	1.62E-02	3.23E-03

Calculations - Annual Operations

Blasting Sources

(Emission Factor Source: Wyoming Department of Environmental Quality, Air Quality Division (1/24/79 Memorandum regarding Emission Factors for Open-Pit (Coal) Mines))

Emission Factor Calculation

EF_{TSP} = 50.00 lbs/blast

EF_{PM10} = 0.5 x EF_{TSP} = 25.00 lbs/blast (Assumption)

Emission Unit		lbs/blast EF_{TSP}	lbs/blast EF_{PM10}	Blasts/time	Emission Controls ECF	Emission Controls Technology	Cntrld Emission (lbs/time) TSP	PM10
1.003	Blasting - Waste Rock	50	25.00	78.93	0%	(Uncontrolled)	3.95E+03	1.97E+03
1.004	Blasting - Ore	50	25.00	26.31	0%	(Uncontrolled)	1.32E+03	6.58E+02

Emission Unit		Controlled Emissions (lbs/time) Sb	As	Be	Cd	Cr	Co	Pb	Mn
1.003	Blasting - Waste Rock	5.19E-02	2.34E-01	7.89E-03	1.97E-02	4.30E-01	5.40E-02	1.97E-02	2.40E+00
1.004	Blasting - Ore	4.31E-02	2.36E-01	2.63E-03	7.24E-03	1.05E-01	1.51E-02	1.74E-02	1.02E+00

Emission Unit		Controlled Emissions (lbs/time) Hg	Ni	Se
1.003	Blasting - Waste Rock	1.57E-03	7.89E-02	1.97E-02
1.004	Blasting - Ore	5.28E-04	3.29E-02	6.58E-03

Drop Point Sources

(Emission Factor Source: AP-42 (5th Ed.) §13.2.4 - Aggregate Handling and Storage Piles)

EF_{TSP} (lbs/ton) = K x (0.0032) x {[(U/5)^1.3]/[(M/2)^1.4]}

EF_{PM10} (lbs/ton) = K x (0.0032) x {[(U/5)^1.3]/[(M/2)^1.4]}

Where:

K = Particle Size Multiplier (dimensionless)

U = Mean Wind Speed

M = Material Moisture Content

Emission Unit		Mean Wind Speed	Mat. Moisture Content	Emission Factors EF_{TSP}	Emission Factors EF_{PM10}	tons/time	Emission Controls ECF	Emission Controls Technology
1.005	Waste Rock Loading	3.0	3.67	0.0005	0.0002	3.29E+07	0%	(Uncontrolled)
1.006	Ore Loading	3.0	3.67	0.0005	0.0002	1.10E+07	0%	(Uncontrolled)
1.007	Waste Rock Dumping	6.0	3.67	0.0013	0.0006	3.29E+07	0%	(Uncontrolled)
1.008	Ore Dumping	6.0	3.67	0.0013	0.0006	1.10E+07	0%	(Uncontrolled)
2.003	Lime Application to Ore	6.0	1.00	0.0079	0.0037	1.10E+04	70%	(Water Sprays)

Emission Unit		Controlled Emission (lbs/time) TSP	PM_{10}	Sb	As	Be	Cd	Cr
1.005	Waste Rock Loading	1.71E+04	8.10E+03	2.25E-01	1.02E+00	3.42E-02	8.56E-02	1.87E+00
1.006	Ore Loading	5.71E+03	2.70E+03	1.87E-01	1.03E+00	1.14E-02	3.14E-02	4.56E-01
1.007	Waste Rock Dumping	4.21E+04	1.99E+04	5.55E-01	2.50E+00	8.43E-02	2.11E-01	4.59E+00
1.008	Ore Dumping	1.40E+04	6.64E+03	4.61E-01	2.53E+00	2.81E-02	7.73E-02	1.12E+00
2.003	Lime Application to Ore	2.60E+01	1.23E+01	n/a	n/a	n/a	n/a	n/a

Emission Unit		Controlled Emission (lbs/time) Co	Pb	Mn	Hg	Ni	Se
1.005	Waste Rock Loading	2.34E-01	8.56E-02	1.04E+01	6.80E-03	3.42E-01	8.56E-02
1.006	Ore Loading	6.56E-02	7.56E-02	4.43E+00	2.29E-03	1.43E-01	2.85E-02
1.007	Waste Rock Dumping	5.76E-01	2.11E-01	2.56E+01	1.67E-02	8.43E-01	2.11E-01
1.008	Ore Dumping	1.62E-01	1.86E-01	1.09E+01	5.63E-03	3.51E-01	7.02E-02
2.003	Lime Application to Ore	n/a	n/a	n/a	n/a	n/a	n/a

Dozing/Ripping/Spreading

(Source: AP-42 (5th Ed.) Table 11.9-4 (Overburden Dozing))

EF_{TSP} (lbs/hr) = (5.7(s)^1.2) / (M^1.3)

EF_{PM10} (lbs/hr) = 0.75 * {(1.0(s)^1.5)/M^1.4)}

s = Material silt content

M = Material Moisture Content

Emission Unit		Silt Content	Moisture Content	(lbs/hr) EF_{TSP}	(lbs/hr) EF_{PM10}	hrs/time	Emission Controls ECF	Emission Controls Technology
1.009	Waste Rock Dozing	1.40	3.67	1.57E+00	2.01E-01	7,817.42	0%	(Uncontrolled)
2.004	Ore Ripping/Spreading/Dozing	1.26	3.67	1.39E+00	1.72E-01	7,817.42	0%	(Uncontrolled)

Emission Unit		Calculated Emissions (lbs/time) TSP	PM10	Sb	As	Be	Cd	Cr	Co
1.009	Waste Rock Dozing	1.23E+04	1.57E+03	1.62E-01	7.30E-01	2.46E-02	6.15E-02	1.34E+00	1.68E-01
2.004	Ore Ripping/Spreading/Dozing	1.08E+04	1.34E+03	3.56E-01	1.95E+00	2.17E-02	5.97E-02	8.68E-01	1.25E-01

Emission Unit		Calculated Emissions (lbs/time) Pb	Mn	Hg	Ni	Se
1.009	Waste Rock Dozing	6.15E-02	7.48E+00	4.89E-03	2.46E-01	6.15E-02
2.004	Ore Ripping/Spreading/Dozing	1.44E-01	8.43E+00	4.35E-03	2.71E-01	5.42E-02

Calculations - Annual Operations

Emissions from Unpaved Surfaces

(Emission Factor Source: Wyoming Department of Environmental Quality, Air Quality Division (1/24/79 Memorandum regarding Emission Factors for Open-Pit (Coal) Mines))

EF_{TSP} (lbs/VMT) = $0.81 \times (s) \times (S/30)^{n} \times (w/4) \times (0.62)$

EF_{PM10} (lbs/VMT) = $EF_{TSP} \times 0.30$

s =Silt content of road surface material
S = Mean vehicle speed
n = 2 IF S<30 MPH; 1 IF S ≥ 30 MPH
w = Mean number of wheels (x 2 if oversize)
p = No. days with at least 0.01 in. of precipatation/year

Emission Unit		s	S	n	w	p	EF_{TSP}	EF_{PM10}	VMT/time
1.010	Waste Rock Hauling	1.26	22.90	2.00	12.00	25.00	1.11	0.33	292,912.50
1.011	Ore Hauling	1.26	22.90	2.00	12.00	25.00	1.11	0.33	97,637.50
7.002	Water Truck Traffic	1.26	10.00	2.00	6.00	25.00	0.11	0.03	7,080.00
8.001	On-Site Delivery Truck Traffic	1.26	25.00	2.00	18.00	25.00	1.98	0.59	1,430.80
8.002	On-Site Light Vehicle Traffic	1.26	25.00	2.00	5.08	25.00	0.56	0.17	80,482.50
8.003	Off-Site Delivery Truck Traffic	1.26	35.00	1.00	18.00	25.00	3.32	1.00	12,161.80
8.004	Off-Site Light Vehicle Traffic	1.26	35.00	1.00	4.00	25.00	0.74	0.22	471,269.75

Emission Unit		Emission Controls		Controlled Emissions (lbs/time)					
		ECF	Technology	TSP	PM10	Sb	As	Be	Cd
1.010	Waste Rock Hauling	90%	(Watering)	3.24E+04	9.72E+03	4.26E-01	1.92E+00	6.48E-02	1.62E-01
1.011	Ore Hauling	90%	(Watering)	1.08E+04	3.24E+03	1.42E-01	6.41E-01	2.16E-02	5.40E-02
7.002	Water Truck Traffic	95%	(Watering)	3.73E+01	1.12E+01	4.91E-04	2.21E-03	7.47E-05	1.87E-04
8.001	On-Site Delivery Truck Traffic	90%	(Watering)	2.83E+02	8.49E+01	3.72E-03	1.68E-02	5.66E-04	1.41E-03
8.002	On-Site Light Vehicle Traffic	90%	(Watering)	4.49E+03	1.35E+03	5.91E-02	2.66E-01	8.98E-03	2.25E-02
8.003	Off-Site Delivery Truck Traffic	80%	(Chemical Treatment)	8.08E+03	2.42E+03	1.06E-01	4.79E-01	1.62E-02	4.04E-02
8.004	Off-Site Light Vehicle Traffic	80%	(Chemical Treatment)	6.96E+04	2.09E+04	9.16E-01	4.13E+00	1.39E-01	3.48E-01

Emission Unit		Controlled Emissions (lbs/time)						
		Cr	Co	Pb	Mn	Hg	Ni	Se
1.010	Waste Rock Hauling	3.53E+00	4.43E-01	1.62E-01	1.97E+01	1.29E-02	6.48E-01	1.62E-01
1.011	Ore Hauling	1.18E+00	1.48E-01	5.40E-02	6.56E+00	4.29E-03	2.16E-01	5.40E-02
7.002	Water Truck Traffic	4.07E-03	5.10E-04	1.87E-04	2.27E-02	1.48E-05	7.47E-04	1.87E-04
8.001	On-Site Delivery Truck Traffic	3.08E-02	3.87E-03	1.41E-03	1.72E-01	1.12E-04	5.66E-03	1.41E-03
8.002	On-Site Light Vehicle Traffic	4.90E-01	6.14E-02	2.25E-02	2.73E+00	1.78E-03	8.98E-02	2.25E-02
8.003	Off-Site Delivery Truck Traffic	8.81E-01	1.10E-01	4.04E-02	4.91E+00	3.21E-03	1.62E-01	4.04E-02
8.004	Off-Site Light Vehicle Traffic	7.58E+00	9.51E-01	3.48E-01	4.23E+01	2.76E-02	1.39E+00	3.48E-01

Calculations - Annual Operations

Ammonium Nitrate Silo Emissions - Loading/Unloading

(Source: AP-42 (5th Ed.) §8.2; Table 8.2-2 (Ammonium Nitrate Bulk Loading Operations)

EF_{TSP} = 0.02 lbs/ton

$EF_{PM10} = EF_{TSP} * 0.5$ = 0.01 lbs/ton (assumption)

Emission Unit		(lbs/ton)		tons/time	Emission Controls		Calculated Emissions (lbs/time)	
		EF_{TSP}	EF_{PM10}		ECF	Technology	TSP	PM10
1.012	Ammonium Nitrate Prill Silo Loading	0.02	0.010	5,475.00	0%	(Uncontrolled)	1.10E+02	5.48E+01
1.013	Ammonium Nitrate Prill Silo Unloading	0.02	0.010	5,475.00	0%	(Uncontrolled)	1.10E+02	5.48E+01

Silo Emissions - Loading

(Source: AP-42 (5th Ed.) §11.12, Table 11.12-2: Cement Unloading to Elevated Storage Silo (Pneumatic)

EF_{TSP} = *0.2700* lbs/ton (TSP)

$EF_{PM10} = 0.5 * EF_{TSP}$ = *0.1350* lbs/ton (PM_{10}) (assumption)

Emission Unit		(lbs/ton) EF_{TSP}	(lbs/ton) EF_{PM10}	(tons/time)	Emission Controls ECF	Emission Controls Technology	Controlled Emissions (lbs/time) TSP	Controlled Emissions (lbs/time) PM10
2.001	Portable R-O-M Lime Silo Loading	0.2700	0.1350	10,950.00	99%	(Baghouse)	2.96E+01	1.48E+01

Silo Emissions - Loading

(Source: AP-42 (5th Ed.) §11.12, Table 11.12-2: Weigh Hopper Loading)

$EF_{TSP} = (EF_{PM10})$ = *0.0200* lbs/ton (TSP) (assumption)

EF_{PM10} = *0.0200* lbs/ton (PM_{10})

Emission Unit		(lbs/ton) EF_{TSP}	(lbs/ton) EF_{PM10}	(tons/time)	Emission Controls ECF	Emission Controls Technology	Controlled Emissions (lbs/time) TSP	Controlled Emissions (lbs/time) PM10
2.002	Portable R-O-M Lime Hopper Loading	0.0200	0.0200	10,950.00	0%	(Uncontrolled)	2.19E+02	2.19E+02

Wind Erosion

(Source: AP-42 (4th Ed.) §11.2.3 - Aggregate Handling & Storage Piles)

EF_{TSP} (lbs/acre/day) = 1.7 x (s/5) x (f/15) x ((365-p)/235))

EF_{PM10} (lbs/acre/day) = EF_{TSP} x 0.5

s =Silt content of road surface material

f = percentage of time that the unobstructed wind speed exceeds 5.4 m/s (12 mph)

p = No. days with at least 0.01 in. of precipatation/year

Emission Unit		Emission Factor Variables			(lb/acre/day)		Stockpile Size (Acres)
		p	f (%)	s (%)	EF_{TSP}	EF_{PM10}	
1.014	Wind Erosion (Waste Rock Stockpile)	25.00	9.10	1.40	0.42	0.21	40.00
1.015	Wind Erosion (Soil Stockpiles)	25.00	9.10	1.40	0.42	0.21	10.00
2.010	Wind Erosion (Heap Leach Pad) - Non-Leach	25.00	9.10	1.26	0.38	0.19	20.40
2.011	Wind Erosion (Heap Leach Pad) - Leach	25.00	9.10	1.26	0.38	0.19	20.40

Emission Unit		Day/Time	Emission Controls		Controlled Emissions (lbs/time)		
			ECF	Technology	TSP	PM10	Sb
1.014	Wind Erosion (Waste Rock Stockpile)	365.00	0%	(Uncontrolled)	6.10E+03	3.05E+03	8.03E-02
1.015	Wind Erosion (Soil Stockpiles)	365.00	0%	(Uncontrolled)	1.52E+03	7.62E+02	2.01E-02
2.010	Wind Erosion (Heap Leach Pad) - Non-Leach	365.00	0%	(Uncontrolled)	2.80E+03	1.40E+03	9.18E-02
2.011	Wind Erosion (Heap Leach Pad) - Leach	365.00	95%	(Leachate)	1.40E+02	7.00E+01	4.59E-03

Emission Unit		Controlled Emissions (lbs/time)					
		As	Be	Cd	Cr	Co	Pb
1.014	Wind Erosion (Waste Rock Stockpile)	3.62E-01	1.22E-02	3.05E-02	6.65E-01	8.34E-02	3.05E-02
1.015	Wind Erosion (Soil Stockpiles)	9.05E-02	3.05E-03	7.62E-03	1.66E-01	2.08E-02	7.62E-03
2.010	Wind Erosion (Heap Leach Pad) - Non-Leach	5.03E-01	5.60E-03	1.54E-02	2.24E-01	3.22E-02	3.71E-02
2.011	Wind Erosion (Heap Leach Pad) - Leach	2.52E-02	2.80E-04	7.70E-04	1.12E-02	1.61E-03	1.85E-03

Emission Unit		Controlled Emissions (lbs/time)			
		Mn	Hg	Ni	Se
1.014	Wind Erosion (Waste Rock Stockpile)	3.71E+00	2.42E-03	1.22E-01	3.05E-02
1.015	Wind Erosion (Soil Stockpiles)	9.27E-01	6.05E-04	3.05E-02	7.62E-03
2.010	Wind Erosion (Heap Leach Pad) - Non-Leach	2.18E+00	1.12E-03	7.00E-02	1.40E-02
2.011	Wind Erosion (Heap Leach Pad) - Leach	1.09E-01	5.61E-05	3.50E-03	7.00E-04

Crushing Operations

(Source: AP-42 (5th Ed.) §11.24 - Metallic Mineral Processing (Low Moisture Ore) - Split 65% Crushers/35% Screens per EPA Guidance)

EF_{TSP} = *0.7800* lbs/ton (TSP)

EF_{PM10} = *0.0553* lbs/ton (PM_{10})

Emission Unit		(lbs/ton)		(tons/time)	Emission Controls		Controlled Emissions (lbs/time)		
		EF_{TSP}	EF_{PM10}		ECF	Technology	TSP	PM10	Sb
5.001	Jaw Crusher	0.7800	0.0553	478.40	0%	(Uncontrolled)	3.73E+02	2.65E+01	1.22E-02
5.002	Pulverizer	0.7800	0.0553	478.40	0%	(Uncontrolled)	3.73E+02	2.65E+01	1.22E-02

Emission Unit		Controlled Emissions (lbs/time)							
		As	Be	Cd	Cr	Co	Pb	Mn	Hg
5.001	Jaw Crusher	6.71E-02	7.46E-04	2.05E-03	2.99E-02	4.29E-03	4.94E-03	2.90E-01	1.50E-04
5.002	Pulverizer	6.71E-02	7.46E-04	2.05E-03	2.99E-02	4.29E-03	4.94E-03	2.90E-01	1.50E-04

Emission Unit		Cntrld Emissions (lbs/time)	
		Ni	Se
5.001	Jaw Crusher	9.33E-03	1.87E-03
5.002	Pulverizer	9.33E-03	1.87E-03

Mercury Retort Furnace Emissions
(Source: Chemgold Personnel)

Emission Unit		(lbs/hr) EF_{Hg}	hrs/time	Emission Controls ECF	Technology	Ctrld Emissions (lbs/time) Hg
4.001	Mercury Retort Furnace (Electric)	4.13E-06	2,190.00	0%	(Uncontrolled)	9.04E-03

Combustion Emissions - Large Stational Diesel Engines
(Source: AP-42 (5th Ed.) §3.4.2 - Large Uncontrolled Stationary I.C. Engines)

EF_{TSP} =	0.0697 lbs/mmBTU	$EF_{Benzene}$ =	7.06E-04 lbs/mmBTU
EF_{PM10} =	0.0573 lbs/mmBTU	$EF_{Toluene}$ =	2.81E-04 lbs/mmBTU
EF_{SOx} = 1.01 x S =	5.05E-02 lbs/mmBTU	$EF_{Xylenes}$=	1.93E-04 lbs/mmBTU
EF_{NOx} =	3.10E+00 lbs/mmBTU	$EF_{Formaldehyde}$ =	7.89E-05 lbs/mmBTU
EF_{CO} =	8.10E-01 lbs/mmBTU	$EF_{Acetaldehyde}$ =	2.52E-05 lbs/mmBTU
EF_{VOC} =	9.00E-02 lbs/mmBTU	$EF_{Acrolein}$ =	7.88E-06 lbs/mmBTU
		$EF_{Naphthalene}$ =	1.30E-04 lbs/mmBTU

Emission Unit		S	(gal/time)	(mmBTU/gal)	ECF	Technology	Controlled Emissions (lbs/time) TSP	PM10
7.003	Backup Diesel-Fueled Generator	0.05	1,840.00	0.133936	0%	(Uncontrolled)	1.72E+01	1.41E+01

Emission Unit		Controlled Emissions (lbs/time) SOx	NOx	CO	VOC/ROGs	Benzene	Toluene	Xylenes
7.003	Backup Diesel-Fueled Generator	1.24E+01	7.64E+02	2.00E+02	2.22E+01	1.74E-01	6.93E-02	4.76E-02

Emission Unit		Controlled Emissions (lbs/time) Formaldehyde	Acetaldehyde	Acrolein	Naphthalene
7.003	Backup Diesel-Fueled Generator	1.94E-02	6.21E-03	1.94E-03	3.20E-02

Organic Liquid Storage Tanks - Diesel Storage

(Source: Leaking Underground Fuel Tank Field Manual, California State Water Resources Control Board, 1990.)

$EF_{Napthalene}$ =	0.13%		
$EF_{Cadmium}$ =	4.00E-02	ug/g =	4.00E-08 lbs/lb
$EF_{Chromium}$ =	3.60E-01	ug/g =	3.60E-07 lbs/lb
EF_{Cobalt} =	5.00E-02	ug/g =	5.00E-08 lbs/lb
EF_{Lead} =	1.00E-01	ug/g =	1.00E-07 lbs/lb
EF_{Nickel} =	5.00E-02	ug/g =	5.00E-08 lbs/lb
$EF_{Selenium}$ =	2.00E-02	ug/g =	2.00E-08 lbs/lb

(Source of VOC Emission Calcultations: AP-42 (5th Ed.) §7.1 - Liquid Organic Storage Tanks - Calculated Via US EPA Tanks Program (Vers. 2.0))

Emission Unit		Standing Losses lbs/yr (VOCs)	Working Losses lbs/yr (VOCs)	Controlled Emissions (lbs/time) lbs/yr (VOCs)	Napthalene	Cadmium	Chromium
6.001	Main Diesel Tank 1	7.04	63.85	7.09E+01	9.22E-02	2.84E-06	2.55E-05
0	Emission control factor (ECF)	0.28	2.78	3.06E+00	3.98E-03	1.22E-07	1.10E-06

Emission Unit		Controlled Emissions (lbs/time) Cobalt	Lead	Nickel	Selenium
6.001	Main Diesel Tank 1	3.54E-06	7.09E-06	3.54E-06	1.42E-06
0	Emission control factor (ECF)	1.53E-07	3.06E-07	1.53E-07	6.12E-08

Organic Liquid Storage Tanks - Gasoline Storage

(Source: Leaking Underground Fuel Tank Field Manual, California State Water Resources Control Board, 1990.)

$EF_{Benzene}$ =	1.81%		
EF_{Hexane} =	1.87%		
$EF_{2,2,4\text{-}Trimethylpentane}$ =	2.45%		
$EF_{Xylenes}$ =	5.77%		
$EF_{Toluene}$ =	12.27%		
$EF_{Ethylbenzene}$ =	1.61%		
$EF_{Naphalene}$ =	0.29%		
$EF_{Bromine}$ =	2.13E+02	ug/g =	2.13E-04 lbs/lb
$EF_{Cadmium}$ =	4.00E-02	ug/g =	4.00E-08 lbs/lb
$EF_{Chlorine}$ =	1.90E+02	ug/g =	1.90E-04 lbs/lb
EF_{Lead} =	1.30E-02	g/g =	0-Jan-00 lbs/lb

(Source of VOC Emission Calcultations: AP-42 (5th Ed.) §7.1 - Liquid Organic Storage Tanks - Calculated Via US EPA Tanks Program (Vers. 2.0))

Emission Unit		Standing Losses lbs/yr (VOCs)	Working Losses lbs/yr (VOCs)	Controlled Emissions (lbs/yr) lbs/yr (VOCs)	Benzene	Hexane
6.003	Unleaded Gasoline Tank	625.94	563.29	1.19E+03	2.15E+01	2.22E+01

Emission Unit		Controlled Emissions (lbs/yr) 2,2,4-Trimethylpentane	Xylenes	Toluene	Ethylbenzene	Napthalene
6.003	Unleaded Gasoline Tank	2.91E+01	6.86E+01	1.46E+02	1.91E+01	3.45E+00

Emission Unit		Controlled Emissions (lbs/yr) Bromine	Cadmium	Chlorine	Lead
6.003	Unleaded Gasoline Tank	2.53E-01	4.76E-05	2.26E-01	1.55E+01

Organic Liquid Storage Tanks - Ethylene Glycol

(Source of VOC Emission Calcultations: AP-42 (5th Ed.) §7.1 - Liquid Organic Storage Tanks - Calculated Via US EPA Tanks Program (Vers. 2.0))

Emission Unit		% of Ethylene Glycol in Soln.	Standing Losses lbs/yr (VOCs)	Working Losses lbs/yr (VOCs)	Controlled Emissions (lbs/time)	
					lbs/yr (VOCs)	Ethylene Glycol
6.004	Coolant Tank	0.95	0.18	0.02	2.00E-01	1.90E-01

Acid Emissions - Hydrochloric Acid Storage/Use

(Source: Nevada Mining Association Data, 1995)

EF_{HCl} (lb/lb acid consumed) = 0.01 lb/lb (Acid Consumed) x Acid Strength (%) / 100

Emission Unit		Acid Strength	(lbs/lb) EF_{HCl}	lbs/time	Emission Controls ECF	Emission Controls Technology	Ctrld Emission (lbs/time) HCl
3.006	Acid Wash Tank	5%	0.0005	706,616	0%	(Uncontrolled)	3.53E+02
5.004	Waste Acid Tank	n/a [1]	n/a	n/a	n/a	n/a	n/a

[1] Emissions from Emission Unit 5.004 (Waste Acid Tank) included in emission calculations for Unit 3.006.

Hydrocyanic Acid Emissions from Open Top (Pond) Sources

(Emission Factor Source: Domes Study, 1980)

EF_{HCN} = 5.60E-05 lbs/ft2/da

HCN Emissions= Domes Emission (lb/ft2/da)xFactor(t)xFactor(pH)xFactor(c)x MWHCN/MWCN x Pond Size x da/yr x (100%-ECF)

Emission Unit		Exposed Suface Area (ft2)	Average pH of Pond	NaCN Conc. (ppm)	Soln. Temp. (C)	HCN VP (mmHg)	Emission Controls	
							ECF	Technology
2.008	Pregnant Solution Pond	54,400.0	10.6	25.0	30	796	0.00%	(Uncontrolled)
2.009	Barren Solution Pond	54,400.0	10.6	25.0	29	795	0.00%	(Uncontrolled)
3.001	Carbon Adsorbtion Tank 1	100.0	10.6	25.0	30	796	0.00%	(Uncontrolled)
3.002	Carbon Adsorbtion Tank 2	100.0	10.6	25.0	30	796	0.00%	(Uncontrolled)
3.003	Carbon Adsorbtion Tank 3	100.0	10.6	25.0	30	796	0.00%	(Uncontrolled)
3.004	Carbon Adsorbtion Tank 4	100.0	10.6	25.0	30	796	0.00%	(Uncontrolled)
3.005	Carbon Adsorbtion Tank 5	100.0	10.6	25.0	30	796	0.00%	(Uncontrolled)
3.007	Cyanide Make-up Tank	113.0	12.0	240,000.0	29	795	0.00%	(Uncontrolled)
3.008	Strip Tank	38.5	13.5	2,000.0	30	800	0.00%	(Uncontrolled)
3.009	Electrowinning Cell	24.0	13.5	250.0	369	825	0.00%	(Uncontrolled)
5.003	Fume Hood	0.8	12.0	240,000.0	12	790	0.00%	(Uncontrolled)

Hydrocyanic Acid Emissions from Open Top (Pond) Sources - continued

(Emission Factor Source: Domes Study, 1980)

Emission Unit		Soln. Conc. ppm (as CN)	HCN Conc. @ pH	pH Factor	Vapor Press. Factor	Conc. Factor	days/time	lbs/time
2.008	Pregnant Solution Pond	13.27	4.00%	8.00	2.75	0.20	365	5.17E+03
2.009	Barren Solution Pond	13.27	4.00%	8.00	2.75	0.20	365	5.16E+03
3.001	Carbon Adsorbtion Tank 1	13.27	4.00%	8.00	2.75	0.20	365	9.50E+00
3.002	Carbon Adsorbtion Tank 2	13.27	4.00%	8.00	2.75	0.20	365	9.50E+00
3.003	Carbon Adsorbtion Tank 3	13.27	4.00%	8.00	2.75	0.20	365	9.50E+00
3.004	Carbon Adsorbtion Tank 4	13.27	4.00%	8.00	2.75	0.20	365	9.50E+00
3.005	Carbon Adsorbtion Tank 5	13.27	4.00%	8.00	2.75	0.20	365	9.50E+00
3.007	Cyanide Make-up Tank	127,346.94	0.00%	-	2.75	1,950.18	365	0.00E+00
3.008	Strip Tank	1,061.22	0.00%	-	2.77	16.25	365	0.00E+00
3.009	Electrowinning Cell	132.65	0.00%	-	2.85	2.03	365	0.00E+00
5.003	Fume Hood	127,346.94	0.00%	-	2.73	1,950.18	365	0.00E+00

Hydrocyanic Acid Emissions from Heap Leach Pads

(Emission Factor Source: Mesquite Mine AB2588 Air Toxic Inventory Report, Addendum - HCN Emissions from Heap Leaching Operations, 1991)

EF_{HCN} = 420.000 lbs/acre-yr

Emission Unit		Size of Heap Under Leach (Acres)	ECF	yrs/time	Controlled Emissions (lbs/time)
2.007	Cyanide Application and Leaching	20.40	0%	1.00	8.57E+03

Combustion - Mobile Sources (Haul Trucks)

(Source: AP-42 - Vol. 2 (Mobile) (4th Ed.) §II-7 - Heavy Duty Construction Equipment, Table II-7.1, Off-Highway Trucks)

EF_{TSP} = 17.70 lbs/1000 gal

$EF_{PM10} = EF_{TSP} \times 0.52$ = 9.20 lbs/1000 gal

EF_{SOx} = 31.20 lbs/1000 gal

EF_{NOx} = 286.10 lbs/1000 gal

EF_{CO} = 123.46 lbs/1000 gal

EF_{VOC} = 13.60 lbs/1000 gal

Emission Unit		(lbs/1000 gal)						(mgal/time)	Emission Controls	
		EF_{TSP}	EF_{PM10}	EF_{SOx}	EF_{NOx}	EF_{CO}	EF_{VOC}		ECF	Technology
1.016	Haul Truck (Combustion)	17.70	9.20	31.20	286.10	123.46	13.60	2,288.00	0%	(Uncontrolled)

Emission Unit		Controlled Emissions (lbs/time)					
		TSP	PM10	SOx	NOx	CO	VOCs
1.016	Haul Truck (Combustion)	4.05E+04	2.11E+04	7.14E+04	6.55E+05	2.82E+05	3.11E+04

Combustion - Mobile Sources (Dozers)

(Source: AP-42 - Vol. 2 (Mobile) (4th Ed.) §II-7 - Heavy Duty Construction Equipment, Table II-7.1, Wheeled Dozer)

EF_{TSP} = 14.80 lbs/1000 gal

$EF_{PM10} = EF_{TSP} \times 0.52$ = 7.70 lbs/1000 gal

EF_{SOx} = 31.20 lbs/1000 gal

EF_{NOx} = 286.10 lbs/1000 gal

EF_{CO} = 123.46 lbs/1000 gal

EF_{VOC} = 13.60 lbs/1000 gal

Emission Unit		(lbs/1000 gal)						(mgal/time)	Emissions Control	
		EF_{TSP}	EF_{PM10}	EF_{SOx}	EF_{NOx}	EF_{CO}	EF_{VOC}		ECF	Technology
1.017	Mine Dozer (Combustion)	14.80	7.70	31.20	286.10	123.46	13.60	156.35	0%	(Uncontrolled)
2.006	Heap Leach Dozer (Combustion)	14.80	7.70	31.20	286.10	123.46	13.60	156.35	0%	(Uncontrolled)

Emission Unit		Controlled Emissions (lbs/time)					
		TSP	PM10	SOx	NOx	CO	VOCs
1.017	Mine Dozer (Combustion)	2.31E+03	1.20E+03	4.88E+03	4.47E+04	1.93E+04	2.13E+03
2.006	Heap Leach Dozer (Combustion)	2.31E+03	1.20E+03	4.88E+03	4.47E+04	1.93E+04	2.13E+03

Combustion - Mobile Sources (Loaders)

(Source: AP-42 - Vol. 2 (Mobile) (4th Ed.) §II-7 - Heavy Duty Construction Equipment, Table II-7.1, Wheeled Loaders)

EF_{TSP} = 29.30 lbs/1000 gal

$EF_{PM10} = EF_{TSP} \times 0.52$ = 15.24 lbs/1000 gal

EF_{SOx} = 31.20 lbs/1000 gal

EF_{NOx} = 339.82 lbs/1000 gal

EF_{CO} = 98.66 lbs/1000 gal

EF_{VOC} = 43.16 lbs/1000 gal

Emission Unit		(lbs/1000 gal)						(mgal/time)	Emission Control	
		EF_{TSP}	EF_{PM10}	EF_{SOx}	EF_{NOx}	EF_{CO}	EF_{VOC}		ECF	Technology
1.019	Loader (Combustion)	29.30	15.24	31.20	339.82	98.66	43.16	196.57	0%	(Uncontrolled)
1.020	Clean-Up Loader (Combustion)	29.30	15.24	31.20	339.82	98.66	43.16	52.12	0%	(Uncontrolled)

Emission Unit		Controlled Emissions (lbs/time)					
		TSP	PM10	SOx	NOx	CO	VOCs
1.019	Loader (Combustion)	5.76E+03	3.00E+03	6.13E+03	6.68E+04	1.94E+04	8.48E+03
1.020	Clean-Up Loader (Combustion)	1.53E+03	7.94E+02	1.63E+03	1.77E+04	5.14E+03	2.25E+03

Combustion - Mobile Sources (Wheeled Graders)

(Source: AP-42 - Vol. 2 (Mobile) (4th Ed.) §II-7 - Heavy Duty Construction Equipment, Table II-7.1, Wheeled Graders)

EF_{TSP} = 22.20 lbs/1000 gal

$EF_{PM10} = EF_{TSP} \times 0.52$ = 11.54 lbs/1000 gal

EF_{SOx} = 31.20 lbs/1000 gal

EF_{NOx} = 253.84 lbs/1000 gal

EF_{CO} = 54.65 lbs/1000 gal

EF_{VOC} = 12.73 lbs/1000 gal

Emission Unit		(lbs/1000 gal)						(mgal/time)	Emission Controls	
		EF_{TSP}	EF_{PM10}	EF_{SOx}	EF_{NOx}	EF_{CO}	EF_{VOC}		ECF	Technology
2.005	Grader (Combustion)	22.20	11.54	31.20	253.84	54.65	12.73	67.01	0%	(Uncontrolled)

Emission Unit		Controlled Emissions (lbs/time)					
		TSP	PM10	SOx	NOx	CO	VOCs
2.005	Grader (Combustion)	1.49E+03	7.74E+02	2.09E+03	1.70E+04	3.66E+03	8.53E+02

Combustion - Mobile Sources (Off-Highway Trucks)

(Source: AP-42 - Vol. 2 (Mobile) (4th Ed.) §II-7 - Heavy Duty Construction Equipment, Table II-7.1, Off-Highway Trucks)

EF_{TSP} = 17.70 lbs/1000 gal

$EF_{PM10} = EF_{TSP} \times 0.52$ = 9.20 lbs/1000 gal

EF_{SOx} = 31.20 lbs/1000 gal

EF_{NOx} = 286.10 lbs/1000 gal

EF_{CO} = 123.46 lbs/1000 gal

EF_{VOC} = 13.60 lbs/1000 gal

Emission Unit		(lbs/1000 gal)						(mgal/time)	Emission Controls	
		EF_{TSP}	EF_{PM10}	EF_{SOx}	EF_{NOx}	EF_{CO}	EF_{VOC}		ECF	Technology
7.001	Water Truck (Combustion)	17.70	9.20	31.20	286.10	123.46	13.60	127.33	0%	(Uncontrolled)

Emission Unit		Controlled Emissions (lbs/time)					
		TSP	PM10	SOx	NOx	CO	VOCs
7.001	Water Truck (Combustion)	2.25E+03	1.17E+03	3.97E+03	3.64E+04	1.57E+04	1.73E+03

Combustion Emissions - Diesel and Gasoline Fueled Engines

(Source: AP-42 (5th Ed.) §3.3 - Gasoline and Diesel Fueled Industrial Engines)

EF_{TSP} =	*0.5962* lbs/mmBTU	$EF_{Xylenes}$=	2.85E-04 lbs/mmBTU
EF_{PM10} =	*0.3100* lbs/mmBTU	$EF_{Formaldehyde}$ =	1.18E-03 lbs/mmBTU
EF_{SOx} =	0.29 lbs/mmBTU	$EF_{Acetaldehyde}$ =	7.67E-04 lbs/mmBTU
EF_{NOx} =	4.41 lbs/mmBTU	$EF_{Acrolein}$ =	9.25E-05 lbs/mmBTU
EF_{CO} =	0.95 lbs/mmBTU	$EF_{Naphthalene}$ =	8.48E-05 lbs/mmBTU
EF_{VOC} =	0.35 lbs/mmBTU	$EF_{Propylene}$ =	2.58E-03 lbs/mmBTU
$EF_{Benzene}$ =	9.33E-04 lbs/mmBTU	$EF_{1,3\text{-}Butadiene}$ =	3.91E-05 lbs/mmBTU
$EF_{Toluene}$ =	4.89E-04 lbs/mmBTU		

				Control Technology		Controlled Emissions (lbs/time)		
	Emission Unit	(gal/time)	(mmBTU/gal)	ECF	Technology	TSP	PM10	SOx
1.018	Drill Rig (Combustion)	177,693.01	0.133936	0%	(Uncontrolled)	1.42E+04	7.38E+03	6.90E+03

		Controlled Emissions (lbs/time)						
	Emission Unit	NOx	CO	VOC/ROGs	Benzene	Toluene	Xylenes	Formaldehyde
1.018	Drill Rig (Combustion)	1.05E+05	2.26E+04	8.33E+03	2.22E+01	1.16E+01	6.78E+00	2.81E+01

		Controlled Emissions (lbs/time)				
	Emission Unit	Acetaldehyde	Acrolein	Naphthalene	Propylene	1,3-Butadiene
1.018	Drill Rig (Combustion)	1.83E+01	2.20E+00	2.02E+00	6.14E+01	9.31E-01

This page intentionally left blank
for reproduction purposes.

APPENDIX F

SUMMARY REPORT OF CALCULATIONS OF EMISSIONS FROM LIQUID ORGANIC TANKS FROM U.S. EPA TANKS PROGRAM (VERSION 2.0)

TANKS PROGRAM 2.0
EMISSIONS REPORT - SUMMARY FORMAT
TANK IDENTIFICATION AND PHYSICAL CHARACTERISTICS

Identification

Identification No.:	CIP-6.001
City:	Imperial County
State:	CA
Company:	Chemgold Imperial Project
Type of Tank:	Vertical Fixed Roof

Tank Dimensions

Shell Height (ft):	20
Diameter (ft):	19
Liquid Height (ft):	19
Avg. Liquid Height (ft):	15
Volume (gallons):	40000
Turnovers:	100
Net Throughput (gal/yr):	4016000

Paint Characteristics

Shell Color/Shade:	White/White
Shell Condition:	Good
Roof Color/Shade:	White/White
Roof Condition:	Good

Roof Characteristics

Type:	Cone
Height (ft):	0.00
Radius (ft) (Dome Roof):	0.00
Slope (ft/ft) (Cone Roof):	0.0000

Breather Vent Settings

Vacuum Setting (psig):	0.00
Pressure Setting (psig):	0.00

Meteorological Data Used in Emission Calculations: Yuma, Arizona

Mixture/Component	Month	Daily Liquid Surf. Temperatures (deg F) Avg.	Min.	Max.	Liquid Bulk Temp. (deg F)	Vapor Pressures (psia) Avg.	Min.	Max.	Vapor Mol. Weight	Liquid Mass Fract.	Vapor Mass Fract.	Mol. Weight	Basis for Vapor Pressure Calculations
Distillate fuel oil no. 2	All	76.49	69.16	83.82	73.92	0.0110	0.0087	0.0137	130.000			130.00	Option 4: A=12.1010, B=8907.0

Annual Emissions Report

Liquid Contents	Losses (lbs.): Standing	Withdrawal	Total
Distillate fuel oil no. 2	7.04	63.85	70.89
Total:	7.04	63.85	70.89

TANK IDENTIFICATION AND PHYSICAL CHARACTERISTICS

Identification

Identification No.:	CIP-6.002
City:	Imperial County
State:	CA
Company:	Chemgold Imperial Project
Type of Tank:	Vertical Fixed Roof

Tank Dimensions

Shell Height (ft):	10
Diameter (ft):	6
Liquid Height (ft):	10
Avg. Liquid Height (ft):	8
Volume (gallons):	2000
Turnovers:	55
Net Throughput (gal/yr):	109600

Paint Characteristics

Shell Color/Shade:	White/White
Shell Condition:	Good
Roof Color/Shade:	White/White
Roof Condition:	Good

Roof Characteristics

Type:	Cone
Height (ft):	0.00
Radius (ft) (Dome Roof):	0.00
Slope (ft/ft) (Cone Roof):	0.0000

Breather Vent Settings

Vacuum Setting (psig):	0.00
Pressure Setting (psig):	0.00

Meteorological Data Used in Emission Calculations: Yuma, Arizona

TANKS PROGRAM 2.0
EMISSIONS REPORT - SUMMARY FORMAT
LIQUID CONTENTS OF STORAGE TANK

Mixture/Component	Month	Daily Liquid Surf. Temperatures (deg F) Avg.	Min.	Max.	Liquid Bulk Temp. (deg F)	Vapor Pressures (psia) Avg.	Min.	Max.	Vapor Mol. Weight	Liquid Mass Fract.	Vapor Mass Fract.	Mol. Weight	Basis for Vapor Pressure Calculations
Distillate fuel oil no. 2	All	76.49	69.16	83.82	73.92	0.0110	0.0087	0.0137	130.000			130.00	Option 4: A=12.1010, B=8907.0

Annual Emissions Report

Liquid Contents	Losses (lbs.): Standing	Withdrawal	Total
Distillate fuel oil no. 2	0.28	2.78	3.06
Total:	0.28	2.78	3.06

TANK IDENTIFICATION AND PHYSICAL CHARACTERISTICS

Identification

Identification No.:	CIP-6.003
City:	Imperial County
State:	CA
Company:	Chemgold Imperial Project
Type of Tank:	Vertical Fixed Roof

Tank Dimensions

Shell Height (ft):	10
Diameter (ft):	6
Liquid Height (ft):	10
Avg. Liquid Height (ft):	7
Volume (gallons):	2000
Turnovers:	21
Net Throughput (gal/yr):	41200

Paint Characteristics

Shell Color/Shade:	White/White
Shell Condition:	Good
Roof Color/Shade:	White/White
Roof Condition:	Good

Roof Characteristics

Type:	Cone
Height (ft):	0.00
Radius (ft) (Dome Roof):	0.00
Slope (ft/ft) (Cone Roof):	0.0000

Breather Vent Settings

Vacuum Setting (psig):	0.00
Pressure Setting (psig):	0.00

Meteorological Data Used in Emission Calculations: Yuma, Arizona

Mixture/Component	Month	Daily Liquid Surf. Temperatures (deg F) Avg.	Min.	Max.	Liquid Bulk Temp. (deg F)	Vapor Pressures (psia) Avg.	Min.	Max.	Vapor Mol. Weight	Liquid Mass Fract.	Vapor Mass Fract.	Mol. Weight	Basis for Vapor Pressure Calculations
Gasoline (RVP 13)	All	76.49	69.16	83.82	73.92	9.2617	8.1111	10.5377	62.000			62.00	Option 4: RVP=13.00, ASTM Slope=2.5

Annual Emissions Report

Liquid Contents	Losses (lbs.): Standing	Withdrawal	Total
Gasoline (RVP 13)	625.94	563.29	1189.23
Total:	625.94	563.29	1189.23

Identification

Identification No.:	CIP-6.004
City:	Imperial County
State:	CA
Company:	Chemgold Imperial Project
Type of Tank:	Horizontal Fixed Roof

Tank Dimensions

Shell Length (ft):	14
Diameter (ft):	7
Volume(gallons):	5000
Is tank underground? (Y/N):	N
Turnovers:	1
Net Throughput (gal/yr):	5000

Paint Characteristics

Shell Color/Shade:	White/White
Shell Condition:	Good

Breather Vent Settings

Vacuum Setting (psig):	0.00
Pressure Setting (psig):	0.00

Meteorological Data Used in Emission Calculations: Yuma, Arizona

Mixture/Component	Month	Daily Liquid Surf. Temperatures (deg F) Avg.	Min.	Max.	Liquid Bulk Temp. (deg F)	Vapor Pressures (psia) Avg.	Min.	Max.	Vapor Mol. Weight	Liquid Mass Fract.	Vapor Mass Fract.	Mol. Weight	Basis for Vapor Pressure Calculations
Ethylene glycol	All	76.49	69.16	83.82	73.92	0.0024	0.0018	0.0034	62.070			62.07	Option 3: A=58703.416, B=9.3947

Annual Emissions Report

Liquid Contents	Losses (lbs.): Standing	Withdrawal	Total
Ethylene glycol	0.18	0.02	0.20
Total:	0.18	0.02	0.20

TANKS PROGRAM 2.0
EMISSIONS REPORT - SUMMARY FORMAT
TOTAL EMISSION SUMMARY - ALL TANKS IN REPORT

Tank Identification				Losses (lb)
CIP-6.001	Chemgold Imperial Project	Vertical Fixed Roof	Imperial County, CA	70.89
CIP-6.002	Chemgold Imperial Project	Vertical Fixed Roof	Imperial County, CA	3.06
CIP-6.003	Chemgold Imperial Project	Vertical Fixed Roof	Imperial County, CA	1189.23
CIP-6.004	Chemgold Imperial Project	Horizontal Fixed Roof	Imperial County, CA	0.20
Total Emissions for all Tanks:				1263.37

This page intentionally left blank
for reproduction purposes.

APPENDIX G

TOTAL CALCULATED REGULATED (CRITERIA) AIR POLLUTANT EMISSIONS

Chemgold Imperial Project
Imperial County, California

Air Pollution Emission Inventory

Summary of Total Calculated Emissions of Regulated Air Pollutants

Emission Unit No.	Emission Unit Description	Regulated Air Pollutants											
		TSP		PM10		SOx		NOx		CO		VOCs/ROGs	
		(lbs/day)	(tons/yr)	(lbs/day)	(tons/yr)	(lbs/day)	(tons/yr)	(lbs/day)	(tons/yr)	(lbs/day)	(tons/yr)	(lbs/day)	(tons/yr)
Emission Unit Group 1: Mining Activity													
1.001	Drilling - Waste Rock	5.27E+00	9.70E-01	2.63E+00	4.85E-01	-	-	-	-	-	-	-	-
1.002	Drilling - Ore	1.76E+00	3.23E-01	8.78E-01	1.62E-01	-	-	-	-	-	-	-	-
1.003	Blasting - Waste Rock	5.00E+01	1.97E+00	2.50E+01	9.87E-01	-	-	-	-	-	-	-	-
1.004	Blasting - Ore	0.00E+00	6.58E-01	0.00E+00	3.29E-01	-	-	-	-	-	-	-	-
1.005	Waste Rock Loading	5.08E+01	8.56E+00	2.40E+01	4.05E+00	-	-	-	-	-	-	-	-
1.006	Ore Loading	1.69E+01	2.85E+00	8.01E+00	1.35E+00	-	-	-	-	-	-	-	-
1.007	Waste Rock Dumping	1.25E+02	2.11E+01	5.92E+01	9.97E+00	-	-	-	-	-	-	-	-
1.008	Ore Dumping	4.17E+01	7.02E+00	1.97E+01	3.32E+00	-	-	-	-	-	-	-	-
1.009	Waste Rock Dozing	3.37E+01	6.15E+00	4.31E+00	7.87E-01	-	-	-	-	-	-	-	-
1.010	Waste Rock Hauling	9.62E+01	1.62E+01	2.88E+01	4.86E+00	-	-	-	-	-	-	-	-
1.011	Ore Hauling	3.21E+01	5.40E+00	9.62E+00	1.62E+00	-	-	-	-	-	-	-	-
1.012	Ammonium Nitrate Prill Silo Loading	5.00E-01	5.48E-02	2.50E-01	2.74E-02	-	-	-	-	-	-	-	-
1.013	Ammonium Nitrate Prill Silo Unloading	2.97E-01	5.48E-02	1.49E-01	2.74E-02	-	-	-	-	-	-	-	-
1.014	Wind Erosion (Waste Rock Stockpile)	1.79E+01	3.05E+00	8.97E+00	1.52E+00	-	-	-	-	-	-	-	-
1.015	Wind Erosion (Soil Stockpiles)	4.49E+00	7.62E-01	2.24E+00	3.81E-01	-	-	-	-	-	-	-	-
1.016	Haul Truck (Combustion)	1.11E+02	2.02E+01	5.75E+01	1.05E+01	1.95E+02	3.57E+01	1.79E+03	3.27E+02	7.71E+02	1.41E+02	8.50E+01	1.56E+01
1.017	Mine Dozer (Combustion)	6.34E+00	1.16E+00	3.30E+00	6.02E-01	1.34E+01	2.44E+00	1.23E+02	2.24E+01	5.29E+01	9.65E+00	5.83E+00	1.06E+00
1.018	Drill Rig (Combustion)	3.83E+01	7.09E+00	1.99E+01	3.69E+00	1.86E+01	3.45E+00	2.84E+02	5.25E+01	6.11E+01	1.13E+01	2.25E+01	4.16E+00
1.019	Loader (Combustion)	1.58E+01	2.88E+00	8.21E+00	1.50E+00	1.68E+01	3.07E+00	1.83E+02	3.34E+01	5.31E+01	9.70E+00	2.32E+01	4.24E+00
1.020	Clean-Up Loader (Combustion)	4.18E+00	7.64E-01	2.18E+00	3.97E-01	4.46E+00	8.13E-01	4.85E+01	8.86E+00	1.41E+01	2.57E+00	6.16E+00	1.12E+00
SUBTOTAL - EMISSION UNIT GROUP 1		***6.52E+02***	***1.07E+02***	***2.85E+02***	***4.66E+01***	***2.48E+02***	***4.55E+01***	***2.42E+03***	***4.44E+02***	***9.52E+02***	***1.74E+02***	***1.43E+02***	***2.62E+01***
Emission Unit Group 2: Heap Leaching Activity													
2.001	Portable R-O-M Lime Silo Loading	1.35E-01	1.48E-02	6.75E-02	7.39E-03	-	-	-	-	-	-	-	-
2.002	Portable R-O-M Lime Hopper Loading	6.50E-01	1.10E-01	6.50E-01	1.10E-01	-	-	-	-	-	-	-	-
2.003	Lime Application to Ore	7.72E-02	1.30E-02	3.65E-02	6.15E-03	-	-	-	-	-	-	-	-
2.004	Ore Ripping/Spreading/Dozing	2.97E+01	5.42E+00	3.68E+00	6.72E-01	-	-	-	-	-	-	-	-
2.005	Grader (Combustion)	4.08E+00	7.44E-01	2.12E+00	3.87E-01	5.73E+00	1.05E+00	4.66E+01	8.51E+00	1.00E+01	1.83E+00	2.34E+00	4.27E-01
2.006	Heap Leach Dozer (Combustion)	6.34E+00	1.16E+00	3.30E+00	6.02E-01	1.34E+01	2.44E+00	1.23E+02	2.24E+01	5.29E+01	9.65E+00	5.83E+00	1.06E+00
2.007	Cyanide Application and Leaching	-	-	-	-	-	-	-	-	-	-	-	-
2.008	Pregnant Solution Pond	-	-	-	-	-	-	-	-	-	-	-	-
2.009	Barren Solution Pond	-	-	-	-	-	-	-	-	-	-	-	-
2.010	Wind Erosion (Heap Leach Pad) - Non-Leach	8.23E+00	1.40E+00	4.12E+00	7.00E-01	-	-	-	-	-	-	-	-
2.011	Wind Erosion (Heap Leach Pad) - Leach	4.12E-01	7.00E-02	2.06E-01	3.50E-02	-	-	-	-	-	-	-	-
SUBTOTAL - EMISSION UNIT GROUP 2		***4.96E+01***	***8.93E+00***	***1.42E+01***	***2.52E+00***	***1.91E+01***	***3.48E+00***	***1.69E+02***	***3.09E+01***	***6.29E+01***	***1.15E+01***	***8.16E+00***	***1.49E+00***
Emission Unit Group 3: Process Plant													
3.001	Carbon Adsorption Tank 1	-	-	-	-	-	-	-	-	-	-	-	-
3.002	Carbon Adsorption Tank 2	-	-	-	-	-	-	-	-	-	-	-	-
3.003	Carbon Adsorption Tank 3	-	-	-	-	-	-	-	-	-	-	-	-
3.004	Carbon Adsorption Tank 4	-	-	-	-	-	-	-	-	-	-	-	-
3.005	Carbon Adsorption Tank 5	-	-	-	-	-	-	-	-	-	-	-	-
3.006	Acid Wash Tank	-	-	-	-	-	-	-	-	-	-	-	-
3.007	Cyanide Make-up Tank	-	-	-	-	-	-	-	-	-	-	-	-

Chemgold Imperial Project
Air Pollution Emission Inventory
Summary of Total Calculated Emissions of Regulated Air Pollutants

Emission Unit No.	Emission Unit Description	Regulated Air Pollutants											
		TSP		PM10		SOx		NOx		CO		VOCs/ROGs	
		(lbs/day)	(tons/yr)	(lbs/day)	(tons/yr)	(lbs/day)	(tons/yr)	(lbs/day)	(tons/yr)	(lbs/day)	(tons/yr)	(lbs/day)	(tons/yr)
	Emission Unit Group 3: Process Plant (continued)												
3.008	Strip Tank	-	-	-	-	-	-	-	-	-	-	-	-
3.009	Electrowinning Cell	-	-	-	-	-	-	-	-	-	-	-	-
	SUBTOTAL - EMISSION UNIT GROUP 3	***0.00E+00***	***0.00E+00***	***0.00E+00***	***0.00E+00***	***0.00E+00***	***0.00E+00***	***0.00E+00***	***0.00E+00***	***0.00E+00***	***0.00E+00***	***0.00E+00***	***0.00E+00***
	Emission Unit Group 4: Refining												
4.001	Mercury Retort Furnace (Electric)	-	-	-	-	-	-	-	-	-	-	-	-
	SUBTOTAL - EMISSION UNIT GROUP 4	***0.00E+00***	***0.00E+00***	***0.00E+00***	***0.00E+00***	***0.00E+00***	***0.00E+00***	***0.00E+00***	***0.00E+00***	***0.00E+00***	***0.00E+00***	***0.00E+00***	***0.00E+00***
	Emission Unit Group 5: Laboratory												
5.001	Jaw Crusher	1.02E+00	1.87E-01	7.24E-02	1.32E-02	-	-	-	-	-	-	-	-
5.002	Pulverizer	1.02E+00	1.87E-01	7.24E-02	1.32E-02	-	-	-	-	-	-	-	-
5.003	Fume Hood	-	-	-	-	-	-	-	-	-	-	-	-
5.004	Waste Acid Tank	-	-	-	-	-	-	-	-	-	-	-	-
	SUBTOTAL - EMISSION UNIT GROUP 5	***2.04E+00***	***3.73E-01***	***1.45E-01***	***2.65E-02***	***0.00E+00***	***0.00E+00***	***0.00E+00***	***0.00E+00***	***0.00E+00***	***0.00E+00***	***0.00E+00***	***0.00E+00***
	Emission Unit Group 6: Shop Area												
6.001	Main Diesel Tank 1	-	-	-	-	-	-	-	-	-	-	1.94E-01	3.54E-02
6.002	Street Diesel Tank	-	-	-	-	-	-	-	-	-	-	8.38E-03	1.53E-03
6.003	Unleaded Gasoline Tank	-	-	-	-	-	-	-	-	-	-	3.26E+00	5.95E-01
6.004	Coolant Tank	-	-	-	-	-	-	-	-	-	-	5.48E-04	1.00E-04
	SUBTOTAL - EMISSION UNIT GROUP 6	***0.00E+00***	***0.00E+00***	***0.00E+00***	***0.00E+00***	***0.00E+00***	***0.00E+00***	***0.00E+00***	***0.00E+00***	***0.00E+00***	***0.00E+00***	***3.46E+00***	***6.32E-01***
	Emission Unit Group 7: Mine & Process Area Support Activities												
7.001	Water Truck (Combustion)	6.72E+00	1.13E+00	3.50E+00	5.86E-01	1.19E+01	1.99E+00	1.09E+02	1.82E+01	4.69E+01	7.86E+00	5.17E+00	8.66E-01
7.002	Water Truck Traffic	1.05E-01	1.87E-02	3.16E-02	5.60E-03	-	-	-	-	-	-	-	-
7.003	Backup Diesel-Fueled Generator	0.00E+00	8.59E-03	0.00E+00	7.06E-03	0.00E+00	6.22E-03	0.00E+00	3.82E-01	0.00E+00	9.98E-02	0.00E+00	1.11E-02
	SUBTOTAL - EMISSION UNIT GROUP 7	***6.83E+00***	***1.15E+00***	***3.53E+00***	***5.99E-01***	***1.19E+01***	***1.99E+00***	***1.09E+02***	***1.86E+01***	***4.69E+01***	***7.96E+00***	***5.17E+00***	***8.77E-01***
	Emission Unit Group 8: Other Mobile Emission Units												
8.001	On-Site Delivery Truck Traffic	7.75E-01	1.41E-01	2.33E-01	4.24E-02	-	-	-	-	-	-	-	-
8.002	On-Site Light Vehicle Traffic	1.23E+01	2.25E+00	3.69E+00	6.74E-01	-	-	-	-	-	-	-	-
8.003	Off-Site Delivery Truck Traffic	2.21E+01	4.04E+00	6.64E+00	1.21E+00	-	-	-	-	-	-	-	-
8.004	Off-Site Light Vehicle Traffic	1.91E+02	3.48E+01	5.72E+01	1.04E+01	-	-	-	-	-	-	-	-
	SUBTOTAL - EMISSION UNIT GROUP 8	***2.26E+02***	***4.12E+01***	***6.78E+01***	***1.24E+01***	***0.00E+00***	***0.00E+00***	***0.00E+00***	***0.00E+00***	***0.00E+00***	***0.00E+00***	***0.00E+00***	***0.00E+00***
	TOTAL - ALL EMISSION UNIT GROUPS	**9.36E+02**	**1.59E+02**	**3.71E+02**	**6.21E+01**	**2.79E+02**	**5.09E+01**	**2.70E+03**	**4.94E+02**	**1.06E+03**	**1.94E+02**	**1.59E+02**	**2.92E+01**

APPENDIX H

TOTAL FACILITY POTENTIAL TO EMIT FOR TITLE V APPLICABLE REGULATED (CRITERIA) AIR POLLUTANTS

Chemgold Imperial Project
Imperial County, California

Air Pollution Emission Inventory

Total Potential to Emit for all Title V Applicable Regulated Air Pollutants

Emission Unit No.	Emission Unit Description	Regulated Air Pollutants (lbs/unit time)					
		TSP	PM10	SOx	NOx	CO	VOCs/ROGs
Emission Unit Group 1: Mining Activity							
1.001	Drilling - Waste Rock	-	-	-	-	-	-
1.002	Drilling - Ore	-	-	-	-	-	-
1.003	Blasting - Waste Rock	-	-	-	-	-	-
1.004	Blasting - Ore	-	-	-	-	-	-
1.005	Waste Rock Loading	-	-	-	-	-	-
1.006	Ore Loading	-	-	-	-	-	-
1.007	Waste Rock Dumping	-	-	-	-	-	-
1.008	Ore Dumping	-	-	-	-	-	-
1.009	Waste Rock Dozing	-	-	-	-	-	-
1.010	Waste Rock Hauling	-	-	-	-	-	-
1.011	Ore Hauling	-	-	-	-	-	-
1.012	Ammonium Nitrate Prill Silo Loading	1.10E+02	5.48E+01	-	-	-	-
1.013	Ammonium Nitrate Prill Silo Unloading	1.10E+02	5.48E+01	-	-	-	-
1.014	Wind Erosion (Waste Rock Stockpile)	-	-	-	-	-	-
1.015	Wind Erosion (Soil Stockpiles)	-	-	-	-	-	-
1.016	Haul Truck (Combustion)	-	-	-	-	-	-
1.017	Mine Dozer (Combustion)	-	-	-	-	-	-
1.018	Drill Rig (Combustion)	-	-	-	-	-	-
1.019	Loader (Combustion)	-	-	-	-	-	-
1.020	Clean-Up Loader (Combustion)	-	-	-	-	-	-
	SUBTOTAL - EMISSION UNIT GROUP 1	**2.19E+02**	**1.10E+02**	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**
Emission Unit Group 2: Heap Leaching Activity							
2.001	Portable R-O-M Lime Silo Loading	2.96E+01	1.48E+01	-	-	-	-
2.002	Portable R-O-M Lime Hopper Loading	2.19E+02	2.19E+02	-	-	-	-
2.003	Lime Application to Ore	-	-	-	-	-	-
2.004	Ore Ripping/Spreading/Dozing	-	-	-	-	-	-
2.005	Grader (Combustion)	-	-	-	-	-	-
2.006	Heap Leach Dozer (Combustion)	-	-	-	-	-	-
2.007	Cyanide Application and Leaching	-	-	-	-	-	-
2.008	Pregnant Solution Pond	-	-	-	-	-	-
2.009	Barren Solution Pond	-	-	-	-	-	-
2.010	Wind Erosion (Heap Leach Pad) - Non-Leach	-	-	-	-	-	-
2.011	Wind Erosion (Heap Leach Pad) - Leach	-	-	-	-	-	-
	SUBTOTAL - EMISSION UNIT GROUP 2	**2.49E+02**	**2.34E+02**	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**
Emission Unit Group 3: Process Plant							
3.001	Carbon Adsorption Tank 1	-	-	-	-	-	-
3.002	Carbon Adsorption Tank 2	-	-	-	-	-	-
3.003	Carbon Adsorption Tank 3	-	-	-	-	-	-
3.004	Carbon Adsorption Tank 4	-	-	-	-	-	-
3.005	Carbon Adsorption Tank 5	-	-	-	-	-	-
3.006	Acid Wash Tank	-	-	-	-	-	-
3.007	Cyanide Make-up Tank	-	-	-	-	-	-
3.008	Strip Tank	-	-	-	-	-	-
3.009	Electrowinning Cell	-	-	-	-	-	-
	SUBTOTAL - EMISSION UNIT GROUP 3	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**
Emission Unit Group 4: Refining							
4.001	Mercury Retort Furnace (Electric)	-	-	-	-	-	-
	SUBTOTAL - EMISSION UNIT GROUP 4	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**

Chemgold Imperial Project
Air Pollution Emission Inventory
Total Potential to Emit for all Title V Applicable Regulated Air Pollutants

Emission Unit No.	Emission Unit Description	Criteria Air Pollutants (lbs/unit time)					
		TSP	PM10	SOx	NOx	CO	VOCs/ROGs
Emission Unit Group 5: Laboratory							
5.001	Jaw Crusher	-	-	-	-	-	-
5.002	Pulverizer	-	-	-	-	-	-
5.003	Fume Hood	-	-	-	-	-	-
5.004	Waste Acid Tank	-	-	-	-	-	-
	SUBTOTAL - EMISSION UNIT GROUP 5	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**
Emission Unit Group 6: Shop Area							
6.001	Main Diesel Tank 1	-	-	-	-	-	7.09E+01
6.002	Street Diesel Tank	-	-	-	-	-	3.06E+00
6.003	Unleaded Gasoline Tank	-	-	-	-	-	1.19E+03
6.004	Coolant Tank	-	-	-	-	-	2.00E-01
	SUBTOTAL - EMISSION UNIT GROUP 6	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**	**1.26E+03**
Emission Unit Group 7: Mine & Process Area Support Activities							
7.001	Water Truck (Combustion)	-	-	-	-	-	-
7.002	Water Truck Traffic	-	-	-	-	-	-
7.003	Backup Diesel-Fueled Generator	1.72E+01	1.41E+01	1.24E+01	7.64E+02	2.00E+02	2.22E+01
	SUBTOTAL - EMISSION UNIT GROUP 7	**1.72E+01**	**1.41E+01**	**1.24E+01**	**7.64E+02**	**2.00E+02**	**2.22E+01**
Emission Unit Group 8: Other Mobile Emission Units							
8.001	On-Site Delivery Truck Traffic	-	-	-	-	-	-
8.002	On-Site Light Vehicle Traffic	-	-	-	-	-	-
8.003	Off-Site Delivery Truck Traffic	-	-	-	-	-	-
8.004	Off-Site Light Vehicle Traffic	-	-	-	-	-	-
	SUBTOTAL - EMISSION UNIT GROUP 8	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**
	TOTAL EMISSIONS (lbs/time)	**4.85E+02**	**3.57E+02**	**1.24E+01**	**7.64E+02**	**2.00E+02**	**1.29E+03**
	TOTAL EMISSIONS (tons/time)	**2.42E-01**	**1.79E-01**	**6.22E-03**	**3.82E-01**	**9.98E-02**	**6.43E-01**

APPENDIX I

TOTAL FACILITY POTENTIAL TO EMIT FOR TITLE V APPLICABLE HAZARDOUS AIR POLLUTANTS (HAPs)

Chemgold Imperial Project
Imperial County, California

Air Pollution Emission Inventory

Total Potential to Emit for all Title V Applicable Hazardous Air Pollutants

Emission Unit No.	Emission Unit Description	Hazardous Air Pollutants (lbs/unit time)								
		Sb	As	Be	Cd	Cr	Co	Pb	Mn	Hg
Emission Unit Group 1: Mining Activity										
1.001	Drilling - Waste Rock	2.55E-02	1.15E-01	3.88E-03	9.70E-03	2.11E-01	2.65E-02	9.70E-03	1.18E+00	7.70E-04
1.002	Drilling - Ore	2.12E-02	1.16E-01	1.29E-03	3.56E-03	5.17E-02	7.43E-03	8.57E-03	5.02E-01	2.59E-04
1.003	Blasting - Waste Rock	5.19E-02	2.34E-01	7.89E-03	1.97E-02	4.30E-01	5.40E-02	1.97E-02	2.40E+00	1.57E-03
1.004	Blasting - Ore	4.31E-02	2.36E-01	2.63E-03	7.24E-03	1.05E-01	1.51E-02	1.74E-02	1.02E+00	5.28E-04
1.005	Waste Rock Loading	2.25E-01	1.02E+00	3.42E-02	8.56E-02	1.87E+00	2.34E-01	8.56E-02	1.04E+01	6.80E-03
1.006	Ore Loading	1.87E-01	1.03E+00	1.14E-02	3.14E-02	4.56E-01	6.56E-02	7.56E-02	4.43E+00	2.29E-03
1.007	Waste Rock Dumping	5.55E-01	2.50E+00	8.43E-02	2.11E-01	4.59E+00	5.76E-01	2.11E-01	2.56E+01	1.67E-02
1.008	Ore Dumping	4.61E-01	2.53E+00	2.81E-02	7.73E-02	1.12E+00	1.62E-01	1.86E-01	1.09E+01	5.63E-03
1.009	Waste Rock Dozing	1.62E-01	7.30E-01	2.46E-02	6.15E-02	1.34E+00	1.68E-01	6.15E-02	7.48E+00	4.89E-03
1.010	Waste Rock Hauling	4.26E-01	1.92E+00	6.48E-02	1.62E-01	3.53E+00	4.43E-01	1.62E-01	1.97E+01	1.29E-02
1.011	Ore Hauling	1.42E-01	6.41E-01	2.16E-02	5.40E-02	1.18E+00	1.48E-01	5.40E-02	6.56E+00	4.29E-03
1.012	Ammonium Nitrate Prill Silo Loading	-	-	-	-	-	-	-	-	-
1.013	Ammonium Nitrate Prill Silo Unloading	-	-	-	-	-	-	-	-	-
1.014	Wind Erosion (Waste Rock Stockpile)	8.03E-02	3.62E-01	1.22E-02	3.05E-02	6.65E-01	8.34E-02	3.05E-02	3.71E+00	2.42E-03
1.015	Wind Erosion (Soil Stockpiles)	2.01E-02	9.05E-02	3.05E-03	7.62E-03	1.66E-01	2.08E-02	7.62E-03	9.27E-01	6.05E-04
1.016	Haul Truck (Combustion)	-	-	-	-	-	-	-	-	-
1.017	Mine Dozer (Combustion)	-	-	-	-	-	-	-	-	-
1.018	Drill Rig (Combustion)	-	-	-	-	-	-	-	-	-
1.019	Loader (Combustion)	-	-	-	-	-	-	-	-	-
1.020	Clean-Up Loader (Combustion)	-	-	-	-	-	-	-	-	-
	SUBTOTAL - EMISSION UNIT GROUP 1	**2.40E+00**	**1.15E+01**	**3.00E-01**	**7.61E-01**	**1.57E+01**	**2.00E+00**	**9.29E-01**	**9.48E+01**	**5.96E-02**
Emission Unit Group 2: Heap Leaching Activity										
2.001	Portable R-O-M Lime Silo Loading	-	-	-	-	-	-	-	-	-
2.002	Portable R-O-M Lime Hopper Loading	-	-	-	-	-	-	-	-	-
2.003	Lime Application to Ore	-	-	-	-	-	-	-	-	-
2.004	Ore Ripping/Spreading/Dozing	3.56E-01	1.95E+00	2.17E-02	5.97E-02	8.68E-01	1.25E-01	1.44E-01	8.43E+00	4.35E-03
2.005	Grader (Combustion)	-	-	-	-	-	-	-	-	-
2.006	Heap Leach Dozer (Combustion)	-	-	-	-	-	-	-	-	-
2.007	Cyanide Application and Leaching	-	-	-	-	-	-	-	-	-
2.008	Pregnant Solution Pond	-	-	-	-	-	-	-	-	-
2.009	Barren Solution Pond	-	-	-	-	-	-	-	-	-
2.010	Wind Erosion (Heap Leach Pad) - Non-Leach	9.18E-02	5.03E-01	5.60E-03	1.54E-02	2.24E-01	3.22E-02	3.71E-02	2.18E+00	1.12E-03
2.011	Wind Erosion (Heap Leach Pad) - Leach	4.59E-03	2.52E-02	2.80E-04	7.70E-04	1.12E-02	1.61E-03	1.85E-03	1.09E-01	5.61E-05
	SUBTOTAL - EMISSION UNIT GROUP 2	**4.52E-01**	**2.48E+00**	**2.76E-02**	**7.58E-02**	**1.10E+00**	**1.59E-01**	**1.83E-01**	**1.07E+01**	**5.53E-03**

Chemgold Imperial Project
Air Pollution Emission Inventory
Total Potential to Emit for all Title V Applicable Hazardous Air Pollutants

Emission Unit No.	Emission Unit Description	Hazardous Air Pollutants (lbs/unit time)							
		Ni	Se	Benzene	Toluene	Xylenes	Formaldehyde	Acetaldehyde	Acrolein
Emission Unit Group 1: Mining Activity									
1.001	Drilling - Waste Rock	3.88E-02	9.70E-03	-	-	-	-	-	-
1.002	Drilling - Ore	1.62E-02	3.23E-03	-	-	-	-	-	-
1.003	Blasting - Waste Rock	7.89E-02	1.97E-02	-	-	-	-	-	-
1.004	Blasting - Ore	3.29E-02	6.58E-03	-	-	-	-	-	-
1.005	Waste Rock Loading	3.42E-01	8.56E-02	-	-	-	-	-	-
1.006	Ore Loading	1.43E-01	2.85E-02	-	-	-	-	-	-
1.007	Waste Rock Dumping	8.43E-01	2.11E-01	-	-	-	-	-	-
1.008	Ore Dumping	3.51E-01	7.02E-02	-	-	-	-	-	-
1.009	Waste Rock Dozing	2.46E-01	6.15E-02	-	-	-	-	-	-
1.010	Waste Rock Hauling	6.48E-01	1.62E-01	-	-	-	-	-	-
1.011	Ore Hauling	2.16E-01	5.40E-02	-	-	-	-	-	-
1.012	Ammonium Nitrate Prill Silo Loading	-	-	-	-	-	-	-	-
1.013	Ammonium Nitrate Prill Silo Unloading	-	-	-	-	-	-	-	-
1.014	Wind Erosion (Waste Rock Stockpile)	1.22E-01	3.05E-02	-	-	-	-	-	-
1.015	Wind Erosion (Soil Stockpiles)	3.05E-02	7.62E-03	-	-	-	-	-	-
1.016	Haul Truck (Combustion)	-	-	-	-	-	-	-	-
1.017	Mine Dozer (Combustion)	-	-	-	-	-	-	-	-
1.018	Drill Rig (Combustion)	-	-	-	-	-	-	-	-
1.019	Loader (Combustion)	-	-	-	-	-	-	-	-
1.020	Clean-Up Loader (Combustion)	-	-	-	-	-	-	-	-
SUBTOTAL - EMISSION UNIT GROUP 1		**3.11E+00**	**7.50E-01**	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**
Emission Unit Group 2: Heap Leaching Activity									
2.001	Portable R-O-M Lime Silo Loading	-	-	-	-	-	-	-	-
2.002	Portable R-O-M Lime Hopper Loading	-	-	-	-	-	-	-	-
2.003	Lime Application to Ore	-	-	-	-	-	-	-	-
2.004	Ore Ripping/Spreading/Dozing	2.71E-01	5.42E-02	-	-	-	-	-	-
2.005	Grader (Combustion)	-	-	-	-	-	-	-	-
2.006	Heap Leach Dozer (Combustion)	-	-	-	-	-	-	-	-
2.007	Cyanide Application and Leaching	-	-	-	-	-	-	-	-
2.008	Pregnant Solution Pond	-	-	-	-	-	-	-	-
2.009	Barren Solution Pond	-	-	-	-	-	-	-	-
2.010	Wind Erosion (Heap Leach Pad) - Non-Leach	7.00E-02	1.40E-02	-	-	-	-	-	-
2.011	Wind Erosion (Heap Leach Pad) - Leach	3.50E-03	7.00E-04	-	-	-	-	-	-
SUBTOTAL - EMISSION UNIT GROUP 2		**3.45E-01**	**6.89E-02**	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**

Chemgold Imperial Project
Air Pollution Emission Inventory
Total Potential to Emit for all Title V Applicable Hazardous Air Pollutants

Emission Unit No.	Emission Unit Description	Hazardous Air Pollutants (lbs/unit time)							
		Naphthalene	Propylene	1,3-Butadiene	HCl	HCN	Hexane	2,2,4-Trimethylpentane	Bromine
	Emission Unit Group 1: Mining Activity								
1.001	Drilling - Waste Rock	-	-	-	-	-	-	-	-
1.002	Drilling - Ore	-	-	-	-	-	-	-	-
1.003	Blasting - Waste Rock	-	-	-	-	-	-	-	-
1.004	Blasting - Ore	-	-	-	-	-	-	-	-
1.005	Waste Rock Loading	-	-	-	-	-	-	-	-
1.006	Ore Loading	-	-	-	-	-	-	-	-
1.007	Waste Rock Dumping	-	-	-	-	-	-	-	-
1.008	Ore Dumping	-	-	-	-	-	-	-	-
1.009	Waste Rock Dozing	-	-	-	-	-	-	-	-
1.010	Waste Rock Hauling	-	-	-	-	-	-	-	-
1.011	Ore Hauling	-	-	-	-	-	-	-	-
1.012	Ammonium Nitrate Prill Silo Loading	-	-	-	-	-	-	-	-
1.013	Ammonium Nitrate Prill Silo Unloading	-	-	-	-	-	-	-	-
1.014	Wind Erosion (Waste Rock Stockpile)	-	-	-	-	-	-	-	-
1.015	Wind Erosion (Soil Stockpiles)	-	-	-	-	-	-	-	-
1.016	Haul Truck (Combustion)	-	-	-	-	-	-	-	-
1.017	Mine Dozer (Combustion)	-	-	-	-	-	-	-	-
1.018	Drill Rig (Combustion)	-	-	-	-	-	-	-	-
1.019	Loader (Combustion)	-	-	-	-	-	-	-	-
1.020	Clean-Up Loader (Combustion)	-	-	-	-	-	-	-	-
	SUBTOTAL - EMISSION UNIT GROUP 1	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**
	Emission Unit Group 2: Heap Leaching Activity								
2.001	Portable R-O-M Lime Silo Loading	-	-	-	-	-	-	-	-
2.002	Portable R-O-M Lime Hopper Loading	-	-	-	-	-	-	-	-
2.003	Lime Application to Ore	-	-	-	-	-	-	-	-
2.004	Ore Ripping/Spreading/Dozing	-	-	-	-	-	-	-	-
2.005	Grader (Combustion)	-	-	-	-	-	-	-	-
2.006	Heap Leach Dozer (Combustion)	-	-	-	-	-	-	-	-
2.007	Cyanide Application and Leaching	-	-	-	-	8.57E+03	-	-	-
2.008	Pregnant Solution Pond	-	-	-	-	5.17E+03	-	-	-
2.009	Barren Solution Pond	-	-	-		5.16E+03	-	-	-
2.010	Wind Erosion (Heap Leach Pad) - Non-Leach	-	-	-		-	-	-	-
2.011	Wind Erosion (Heap Leach Pad) - Leach	-	-	-		-	-	-	-
	SUBTOTAL - EMISSION UNIT GROUP 2	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**	**1.89E+04**	**0.00E+00**	**0.00E+00**	**0.00E+00**

Chemgold Imperial Project
Air Pollution Emission Inventory
Total Potential to Emit for all Title V Applicable Hazardous Air Pollutants

Emission Unit No.	Emission Unit Description	Hazardous Air Pollutants (lbs/unit time)			
		Chlorine	Ethylene Glycol	Ethylbenzene	ALL HAPS
Emission Unit Group 1: Mining Activity					
1.001	Drilling - Waste Rock	-	-	-	1.63E+00
1.002	Drilling - Ore	-	-	-	7.32E-01
1.003	Blasting - Waste Rock	-	-	-	3.32E+00
1.004	Blasting - Ore	-	-	-	1.49E+00
1.005	Waste Rock Loading	-	-	-	1.44E+01
1.006	Ore Loading	-	-	-	6.46E+00
1.007	Waste Rock Dumping	-	-	-	3.54E+01
1.008	Ore Dumping	-	-	-	1.59E+01
1.009	Waste Rock Dozing	-	-	-	1.03E+01
1.010	Waste Rock Hauling	-	-	-	2.72E+01
1.011	Ore Hauling	-	-	-	9.07E+00
1.012	Ammonium Nitrate Prill Silo Loading	-	-	-	0.00E+00
1.013	Ammonium Nitrate Prill Silo Unloading	-	-	-	0.00E+00
1.014	Wind Erosion (Waste Rock Stockpile)	-	-	-	5.13E+00
1.015	Wind Erosion (Soil Stockpiles)	-	-	-	1.28E+00
1.016	Haul Truck (Combustion)	-	-	-	0.00E+00
1.017	Mine Dozer (Combustion)	-	-	-	0.00E+00
1.018	Drill Rig (Combustion)	-	-	-	0.00E+00
1.019	Loader (Combustion)	-	-	-	0.00E+00
1.020	Clean-Up Loader (Combustion)	-	-	-	0.00E+00
SUBTOTAL - EMISSION UNIT GROUP 1		**0.00E+00**	**0.00E+00**	**0.00E+00**	**1.32E+02**
Emission Unit Group 2: Heap Leaching Activity					
2.001	Portable R-O-M Lime Silo Loading	-	-	-	**0.00E+00**
2.002	Portable R-O-M Lime Hopper Loading	-	-	-	**0.00E+00**
2.003	Lime Application to Ore	-	-	-	**0.00E+00**
2.004	Ore Ripping/Spreading/Dozing	-	-	-	**1.23E+01**
2.005	Grader (Combustion)	-	-	-	**0.00E+00**
2.006	Heap Leach Dozer (Combustion)	-	-	-	**0.00E+00**
2.007	Cyanide Application and Leaching	-	-	-	**8.57E+03**
2.008	Pregnant Solution Pond	-	-	-	**5.17E+03**
2.009	Barren Solution Pond	-	-	-	**5.16E+03**
2.010	Wind Erosion (Heap Leach Pad) - Non-Leach	-	-	-	**3.17E+00**
2.011	Wind Erosion (Heap Leach Pad) - Leach	-	-	-	**1.59E-01**
SUBTOTAL - EMISSION UNIT GROUP 2		**0.00E+00**	**0.00E+00**	**0.00E+00**	**1.89E+04**

Chemgold Imperial Project
Air Pollution Emission Inventory
Total Potential to Emit for all Title V Applicable Hazardous Air Pollutants

Emission Unit No.	Emission Unit Description	Hazardous Air Pollutants (lbs/unit time)								
		Sb	As	Be	Cd	Cr	Co	Pb	Mn	Hg
Emission Unit Group 2: Heap Leaching Activity										
Emission Unit Group 3: Process Plant										
3.001	Carbon Adsorption Tank 1	-	-	-	-	-	-	-	-	-
3.002	Carbon Adsorption Tank 2	-	-	-	-	-	-	-	-	-
3.003	Carbon Adsorption Tank 3	-	-	-	-	-	-	-	-	-
3.004	Carbon Adsorption Tank 4	-	-	-	-	-	-	-	-	-
3.005	Carbon Adsorption Tank 5	-	-	-	-	-	-	-	-	-
3.006	Acid Wash Tank	-	-	-	-	-	-	-	-	-
3.007	Cyanide Make-up Tank	-	-	-	-	-	-	-	-	-
3.008	Strip Tank	-	-	-	-	-	-	-	-	-
3.009	Electrowinning Cell	-	-	-	-	-	-	-	-	-
SUBTOTAL - EMISSION UNIT GROUP 3		**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**
Emission Unit Group 4: Refining										
4.001	Mercury Retort Furnace (Electric)	-	-	-	-	-	-	-	-	9.04E-03
SUBTOTAL - EMISSION UNIT GROUP 4		**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**	**9.04E-03**
Emission Unit Group 5: Laboratory										
5.001	Jaw Crusher	1.22E-02	6.71E-02	7.46E-04	2.05E-03	2.99E-02	4.29E-03	4.94E-03	2.90E-01	1.50E-04
5.002	Pulverizer	1.22E-02	6.71E-02	7.46E-04	2.05E-03	2.99E-02	4.29E-03	4.94E-03	2.90E-01	1.50E-04
5.003	Fume Hood	-	-	-	-	-	-	-	-	-
5.004	Waste Acid Tank	-	-	-	-	-	-	-	-	-
SUBTOTAL - EMISSION UNIT GROUP 5		**2.45E-02**	**1.34E-01**	**1.49E-03**	**4.10E-03**	**5.97E-02**	**8.58E-03**	**9.89E-03**	**5.80E-01**	**2.99E-04**
Emission Unit Group 6: Shop Area										
6.001	Main Diesel Tank 1	-	-	-	2.84E-06	2.55E-05	3.54E-06	7.09E-06	-	-
6.002	Street Diesel Tank	-	-	-	0.00E+00	0.00E+00	0.00E+00	0.00E+00	-	-
6.003	Unleaded Gasoline Tank	-	-	-	4.76E-05	-	-	1.55E+01	-	-
6.004	Coolant Tank	-	-	-	-	-	-	-	-	-
SUBTOTAL - EMISSION UNIT GROUP 6		**0.00E+00**	**0.00E+00**	**0.00E+00**	**5.04E-05**	**2.55E-05**	**3.54E-06**	**1.55E+01**	**0.00E+00**	**0.00E+00**
Emission Unit Group 7: Mine & Process Area Support Activities										
7.001	Water Truck (Combustion)	-	-	-	-	-	-	-	-	-
7.002	Water Truck Traffic	4.91E-04	2.21E-03	7.47E-05	1.87E-04	4.07E-03	5.10E-04	1.87E-04	2.27E-02	1.48E-05
7.003	Backup Diesel-Fueled Generator	-	-	-	-	-	-	-	-	-
SUBTOTAL - EMISSION UNIT GROUP 7		**4.91E-04**	**2.21E-03**	**7.47E-05**	**1.87E-04**	**4.07E-03**	**5.10E-04**	**1.87E-04**	**2.27E-02**	**1.48E-05**
Emission Unit Group 8: Other Mobile Emission Units										
8.001	On-Site Delivery Truck Traffic	3.72E-03	1.68E-02	5.66E-04	1.41E-03	3.08E-02	3.87E-03	1.41E-03	1.72E-01	1.12E-04
8.002	On-Site Light Vehicle Traffic	5.91E-02	2.66E-01	8.98E-03	2.25E-02	4.90E-01	6.14E-02	2.25E-02	2.73E+00	1.78E-03
8.003	Off-Site Delivery Truck Traffic	-	-	-	-	-	-	-	-	-
8.004	Off-Site Light Vehicle Traffic	-	-	-	-	-	-	-	-	-
SUBTOTAL - EMISSION UNIT GROUP 8		**6.28E-02**	**2.83E-01**	**9.55E-03**	**2.39E-02**	**5.20E-01**	**6.53E-02**	**2.39E-02**	**2.90E+00**	**1.90E-03**
TOTAL EMISSIONS (lbs/time)		***2.94E+00***	***1.44E+01***	***3.39E-01***	***8.65E-01***	***1.74E+01***	***2.24E+00***	***1.66E+01***	***1.09E+02***	***7.64E-02***
TOTAL EMISSIONS (tons/time)		***1.47E-03***	***7.21E-03***	***1.69E-04***	***4.32E-04***	***8.70E-03***	***1.12E-03***	***8.30E-03***	***5.45E-02***	***3.82E-05***

Chemgold Imperial Project
Air Pollution Emission Inventory
Total Potential to Emit for all Title V Applicable Hazardous Air Pollutants

Emission Unit No.	Emission Unit Description	Hazardous Air Pollutants (lbs/unit time)							
		Ni	Se	Benzene	Toluene	Xylenes	Formaldehyde	Acetaldehyde	Acrolein
Emission Unit Group 2: Heap Leaching Activity									
Emission Unit Group 3: Process Plant									
3.001	Carbon Adsorption Tank 1	-	-	-	-	-	-	-	-
3.002	Carbon Adsorption Tank 2	-	-	-	-	-	-	-	-
3.003	Carbon Adsorption Tank 3	-	-	-	-	-	-	-	-
3.004	Carbon Adsorption Tank 4	-	-	-	-	-	-	-	-
3.005	Carbon Adsorption Tank 5	-	-	-	-	-	-	-	-
3.006	Acid Wash Tank	-	-	-	-	-	-	-	-
3.007	Cyanide Make-up Tank	-	-	-	-	-	-	-	-
3.008	Strip Tank	-	-	-	-	-	-	-	-
3.009	Electrowinning Cell	-	-	-	-	-	-	-	-
SUBTOTAL - EMISSION UNIT GROUP 3		**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**
Emission Unit Group 4: Refining									
4.001	Mercury Retort Furnace (Electric)	-	-	-	-	-	-	-	-
SUBTOTAL - EMISSION UNIT GROUP 4		**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**
Emission Unit Group 5: Laboratory									
5.001	Jaw Crusher	9.33E-03	1.87E-03	-	-	-	-	-	-
5.002	Pulverizer	9.33E-03	1.87E-03	-	-	-	-	-	-
5.003	Fume Hood	-	-	-	-	-	-	-	-
5.004	Waste Acid Tank	-	-	-	-	-	-	-	-
SUBTOTAL - EMISSION UNIT GROUP 5		**1.87E-02**	**3.73E-03**	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**
Emission Unit Group 6: Shop Area									
6.001	Main Diesel Tank 1	3.54E-06	1.42E-06	-	-	-	-	-	-
6.002	Street Diesel Tank	0.00E+00	0.00E+00	-	-	-	-	-	-
6.003	Unleaded Gasoline Tank	-	-	2.15E+01	1.46E+02	6.86E+01	-	-	-
6.004	Coolant Tank	-	-	-	-	-	-	-	-
SUBTOTAL - EMISSION UNIT GROUP 6		**3.54E-06**	**1.42E-06**	**2.15E+01**	**1.46E+02**	**6.86E+01**	**0.00E+00**	**0.00E+00**	**0.00E+00**
Emission Unit Group 7: Mine & Process Area Support Activities									
7.001	Water Truck (Combustion)	-	-	-	-	-	-	-	-
7.002	Water Truck Traffic	7.47E-04	1.87E-04	-	-	-	-	-	-
7.003	Backup Diesel-Fueled Generator	-	-	1.74E-01	6.93E-02	4.76E-02	1.94E-02	6.21E-03	1.94E-03
SUBTOTAL - EMISSION UNIT GROUP 7		**7.47E-04**	**1.87E-04**	**1.74E-01**	**6.93E-02**	**4.76E-02**	**1.94E-02**	**6.21E-03**	**1.94E-03**
Emission Unit Group 8: Other Mobile Emission Units									
8.001	On-Site Delivery Truck Traffic	5.66E-03	1.41E-03	-	-	-	-	-	-
8.002	On-Site Light Vehicle Traffic	8.98E-02	2.25E-02	-	-	-	-	-	-
8.003	Off-Site Delivery Truck Traffic	-	-	-	-	-	-	-	-
8.004	Off-Site Light Vehicle Traffic	-	-	-	-	-	-	-	-
SUBTOTAL - EMISSION UNIT GROUP 8		**9.55E-02**	**2.39E-02**	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**
TOTAL EMISSIONS (lbs/time)		***3.57E+00***	***8.47E-01***	***2.17E+01***	***1.46E+02***	***6.87E+01***	***1.94E-02***	***6.21E-03***	***1.94E-03***
TOTAL EMISSIONS (tons/time)		***1.78E-03***	***4.23E-04***	***1.08E-02***	***7.30E-02***	***3.43E-02***	***9.72E-06***	***3.11E-06***	***9.71E-07***

Chemgold Imperial Project
Air Pollution Emission Inventory
Total Potential to Emit for all Title V Applicable Hazardous Air Pollutants

Emission Unit No.	Emission Unit Description	Hazardous Air Pollutants (lbs/unit time)							
		Naphthalene	Propylene	1,3-Butadiene	HCl	HCN	Hexane	2,2,4-Trimethylpentane	Bromine
Emission Unit Group 2: Heap Leaching Activity									
Emission Unit Group 3: Process Plant									
3.001	Carbon Adsorption Tank 1	-	-	-	-	9.50E+00	-	-	-
3.002	Carbon Adsorption Tank 2	-	-	-	-	9.50E+00	-	-	-
3.003	Carbon Adsorption Tank 3	-	-	-	-	9.50E+00	-	-	-
3.004	Carbon Adsorption Tank 4	-	-	-	-	9.50E+00	-	-	-
3.005	Carbon Adsorption Tank 5	-	-	-	-	9.50E+00	-	-	-
3.006	Acid Wash Tank	-	-	-	3.53E+02	-	-	-	-
3.007	Cyanide Make-up Tank	-	-	-	-	0.00E+00	-	-	-
3.008	Strip Tank	-	-	-	-	0.00E+00	-	-	-
3.009	Electrowinning Cell	-	-	-	-	0.00E+00	-	-	-
	SUBTOTAL - EMISSION UNIT GROUP 3	**0.00E+00**	**0.00E+00**	**0.00E+00**	**3.53E+02**	**4.75E+01**	**0.00E+00**	**0.00E+00**	**0.00E+00**
Emission Unit Group 4: Refining									
4.001	Mercury Retort Furnace (Electric)	-	-	-	-	-	-	-	-
	SUBTOTAL - EMISSION UNIT GROUP 4	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**
Emission Unit Group 5: Laboratory									
5.001	Jaw Crusher	-	-	-	-	-	-	-	-
5.002	Pulverizer	-	-	-	-	-	-	-	-
5.003	Fume Hood	-	-	-	-	0.00E+00	-	-	-
5.004	Waste Acid Tank	-	-	-	n/a	-	-	-	-
	SUBTOTAL - EMISSION UNIT GROUP 5	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**
Emission Unit Group 6: Shop Area									
6.001	Main Diesel Tank 1	9.22E-02	-	-	-	-	-	-	-
6.002	Street Diesel Tank	0.00E+00	-	-	-	-	-	-	-
6.003	Unleaded Gasoline Tank	3.45E+00	-	-	-	-	2.22E+01	2.91E+01	2.53E-01
6.004	Coolant Tank	-	-	-	-	-	-	-	-
	SUBTOTAL - EMISSION UNIT GROUP 6	**3.54E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**	**2.22E+01**	**2.91E+01**	**2.53E-01**
Emission Unit Group 7: Mine & Process Area Support Activities									
7.001	Water Truck (Combustion)	-	-	-	-	-	-	-	-
7.002	Water Truck Traffic	-	-	-	-	-	-	-	-
7.003	Backup Diesel-Fueled Generator	3.20E-02	-	-	-	-	-	-	-
	SUBTOTAL - EMISSION UNIT GROUP 7	**3.20E-02**	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**
Emission Unit Group 8: Other Mobile Emission Units									
8.001	On-Site Delivery Truck Traffic	-	-	-	-	-	-	-	-
8.002	On-Site Light Vehicle Traffic	-	-	-	-	-	-	-	-
8.003	Off-Site Delivery Truck Traffic	-	-	-	-	-	-	-	-
8.004	Off-Site Light Vehicle Traffic	-	-	-	-	-	-	-	-
	SUBTOTAL - EMISSION UNIT GROUP 8	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**
	TOTAL EMISSIONS (lbs/time)	***3.57E+00***	***0.00E+00***	***0.00E+00***	***3.53E+02***	***1.89E+04***	***2.22E+01***	***2.91E+01***	***2.53E-01***
	TOTAL EMISSIONS (tons/time)	***1.79E-03***	***0.00E+00***	***0.00E+00***	***1.77E-01***	***9.47E+00***	***1.11E-02***	***1.46E-02***	***1.26E-04***

Chemgold Imperial Project
Air Pollution Emission Inventory
Total Potential to Emit for all Title V Applicable Hazardous Air Pollutants

Emission Unit No.	Emission Unit Description	Hazardous Air Pollutants (lbs/unit time)			
		Chlorine	Ethylene Glycol	Ethylbenzene	ALL HAPS
Emission Unit Group 2: Heap Leaching Activity					
Emission Unit Group 3: Process Plant					
3.001	Carbon Adsorption Tank 1	-	-	-	9.50E+00
3.002	Carbon Adsorption Tank 2	-	-	-	9.50E+00
3.003	Carbon Adsorption Tank 3	-	-	-	9.50E+00
3.004	Carbon Adsorption Tank 4	-	-	-	9.50E+00
3.005	Carbon Adsorption Tank 5	-	-	-	9.50E+00
3.006	Acid Wash Tank	-	-	-	3.53E+02
3.007	Cyanide Make-up Tank	-	-	-	0.00E+00
3.008	Strip Tank	-	-	-	0.00E+00
3.009	Electrowinning Cell	-	-	-	0.00E+00
SUBTOTAL - EMISSION UNIT GROUP 3		0.00E+00	0.00E+00	0.00E+00	4.01E+02
Emission Unit Group 4: Refining					
4.001	Mercury Retort Furnace (Electric)	-	-	-	9.04E-03
SUBTOTAL - EMISSION UNIT GROUP 4		0.00E+00	0.00E+00	0.00E+00	9.04E-03
Emission Unit Group 5: Laboratory					
5.001	Jaw Crusher	-	-	-	4.23E-01
5.002	Pulverizer	-	-	-	4.23E-01
5.003	Fume Hood	-	-	-	0.00E+00
5.004	Waste Acid Tank	-	-	-	0.00E+00
SUBTOTAL - EMISSION UNIT GROUP 5		0.00E+00	0.00E+00	0.00E+00	8.45E-01
Emission Unit Group 6: Shop Area					
6.001	Main Diesel Tank 1	-	-	-	9.22E-02
6.002	Street Diesel Tank	-	-	-	0.00E+00
6.003	Unleaded Gasoline Tank	2.26E-01	-	1.91E+01	3.26E+02
6.004	Coolant Tank	-	1.90E-01	-	1.90E-01
SUBTOTAL - EMISSION UNIT GROUP 6		2.26E-01	1.90E-01	1.91E+01	3.26E+02
Emission Unit Group 7: Mine & Process Area Support Activities					
7.001	Water Truck (Combustion)	-	-	-	0.00E+00
7.002	Water Truck Traffic	-	-	-	3.14E-02
7.003	Backup Diesel-Fueled Generator	-	-	-	3.50E-01
SUBTOTAL - EMISSION UNIT GROUP 7		0.00E+00	0.00E+00	0.00E+00	3.82E-01
Emission Unit Group 8: Other Mobile Emission Units					
8.001	On-Site Delivery Truck Traffic	-	-	-	2.38E-01
8.002	On-Site Light Vehicle Traffic	-	-	-	3.77E+00
8.003	Off-Site Delivery Truck Traffic	-	-	-	0.00E+00
8.004	Off-Site Light Vehicle Traffic	-	-	-	0.00E+00
SUBTOTAL - EMISSION UNIT GROUP 8		0.00E+00	0.00E+00	0.00E+00	4.01E+00
TOTAL EMISSIONS (lbs/time)		***2.26E-01***	***1.90E-01***	***1.91E+01***	1.98E+04
TOTAL EMISSIONS (tons/time)		***1.13E-04***	***9.50E-05***	***9.57E-03***	9.89E+00

APPENDIX J

MODELING SOURCE PARAMETER TABLES

Table 1: Imperial Project Model Source Parameters - Point Sources

Source No.	Source ID	Unit No.	Unit Description	Easting (UTM)	Northing (UTM)	Base Elev (ft)	Stack Height (ft)	Stack Temp (F)	Stack Dia. (ft)	Stack Velocity (fps)	Unit Emis. Rate (#/Day)	Unit Emis. Rate (#/yr)
1	ANSILOLD	1.012	Ammonium Nitrate Prill Silo Loading	706591	3650227	800.00	72.7	80	0.66	26.8	2.50E-01	5.48E+01
2	LIMELOAD	2.001	Portable R-O-M Lime Silo Loading	706572	3650230	800.00	72.7	80	0.66	26.8	6.75E-02	1.48E+01
3	JAWCRUSH	5.001	Jaw Crusher	705358	3649725	760.00	15	80	6.00	0.03	7.24E-02	2.65E+01
4	PULVERIZ	5.002	Pulverizer	705344	3649697	760.00	5	80	6.00	0.03	7.24E-02	2.65E+01
5	DIESGENR	7.003	Backup Diesel-Fueled Generator	705549	3649588	760.00	10	120	0.66	70	0.00E+00	1.41E+01

Table 1: Imperial Project Model Source Parameters - Point Sources (continued)

Source No.	Source ID	Unit No.	Unit Description	Scaled 24-Hr Emis. Rate (#/hr)	Scaled Annual Emis. Rate (#/hr)	Scaled 24-Hr Emis. Rate (g/sec)	Scaled Annual Emis. Rate (g/sec)
1	ANSILOLD	1.012	Ammonium Nitrate Prill Silo Loading	1.04E-02	6.25E-03	1.31E-03	7.88E-04
2	LIMELOAD	2.001	Portable R-O-M Lime Silo Loading	2.81E-03	1.69E-03	3.54E-04	2.13E-04
3	JAWCRUSH	5.001	Jaw Crusher	3.02E-03	3.02E-03	3.80E-04	3.81E-04
4	PULVERIZ	5.002	Pulverizer	3.02E-03	3.02E-03	3.80E-04	3.81E-04
5	DIESGENR	7.003	Backup Diesel-Fueled Generator	0.00E+00	1.61E-03	0.00E+00	2.03E-04

Table 2: Imperial Project Model Source Parameters - Area/Line Sources

Area	Emission Source No.	Emission Source ID	Emission Unit No.	Unit Description	SW Corner Easting (UTM)	Northing (UTM)	Rot. Angle (Deg.)	Base Elevation (ft)	X Length (ft)	Y Length (ft)
Heap Area			1.008	Ore Dumping	706070	3649505	30	900	2297	899
			2.004	Ore Ripping/Spreading/Dozing	706070	3649505	30	900	2297	899
			2.006	Heap Leach Dozer (Combustion)	706070	3649505	30	900	2297	899
			2.010	Wind Erosion (Heap Leach) - Non-Leach	706070	3649505	30	900	2297	899
			2.011	Wind Erosion (Heap Leach Pad) - Leach	706070	3649505	30	900	2297	899
	6	HEAPAREA	N/A	Sum of Heap Area Sources	706070	3649505	30	900	2297	899
Waste Rock SP 1			1.007	Waste Rock Dumping	705324	3649918	30	950	1094	3008
			1.009	Waste Rock Dozing	705324	3649918	30	950	1094	3008
			1.014	Wind Erosion (Waste Rock Stockpile)	705324	3649918	30	950	1094	3008
			1.017	Mine Dozer (Combustion)	705324	3649918	30	950	1094	3008
	7	WASTESP1	N/A	Sum of Waste Rock Stockpile Sources, Section 1	705324	3649918	30	950	1094	3008
Waste Rock SP 2			1.007	Waste Rock Dumping	705727	3649955	30	950	526	2105
			1.009	Waste Rock Dozing	705727	3649955	30	950	526	2105
			1.014	Wind Erosion (Waste Rock Stockpile)	705727	3649955	30	950	526	2105
			1.017	Mine Dozer (Combustion)	705727	3649955	30	950	526	2105
	8	WASTESP2	N/A	Sum of Waste Rock Stockpile Sources, Section 2	705727	3649955	30	950	526	2105
Waste Rock SP 3			1.007	Waste Rock Dumping	705969	3650067	30	950	316	1368
			1.009	Waste Rock Dozing	705969	3650067	30	950	316	1368
			1.014	Wind Erosion (Waste Rock Stockpile)	705969	3650067	30	950	316	1368
			1.017	Mine Dozer (Combustion)	705969	3650067	30	950	316	1368
	9	WASTESP3	N/A	Sum of Waste Rock Stockpile Sources, Section 3	705969	3650067	30	950	316	1368
Waste Rock SP 4			1.007	Waste Rock Dumping	706081	3650067	30	950	158	1000
			1.009	Waste Rock Dozing	706081	3650067	30	950	158	1000
			1.014	Wind Erosion (Waste Rock Stockpile)	706081	3650067	30	950	158	1000
			1.017	Mine Dozer (Combustion)	706081	3650067	30	950	158	1000
	10	WASTESP4	N/A	Sum of Waste Rock Stockpile Sources, Section 4	706081	3650067	30	950	158	1000
Waste Rock SP 5			1.007	Waste Rock Dumping	705936	3650003	30	950	211	211
			1.009	Waste Rock Dozing	705936	3650003	30	950	211	211
			1.014	Wind Erosion (Waste Rock Stockpile)	705936	3650003	30	950	211	211
			1.017	Mine Dozer (Combustion)	705936	3650003	30	950	211	211
	11	WASTESP5	N/A	Sum of Waste Rock Stockpile Sources, Section 5	705936	3650003	30	950	211	211
Haul Rd 1 (Common)			1.010	Waste Rock Hauling	706354	3650693	-15	820	100	632
			1.011	Ore Hauling	706354	3650693	-15	820	100	632
			1.016	Haul Truck (Combustion)	706354	3650693	-15	820	100	632
			2.005	Grader (Combustion)	706354	3650693	-15	820	100	632
			7.001	Water Truck (Combustion)	706354	3650693	-15	820	100	632
			7.002	Water Truck Traffic	706354	3650693	-15	820	100	632
			8.002	On-Site Light Vehicle Traffic	706354	3650693	-15	820	100	632
			8.006	On-Site Light Vehicle (Combustion)	706354	3650693	-15	820	100	632
	12	HAULRD1	N/A	Sum of Haul Road Sources, Section 1 - Common	706354	3650693	-15	820	100	632

Table 2: Imperial Project Model Source Parameters - Area/Line Sources (continued)

Release Height (ft)	Plume Height (ft)	Area (Sq.ft)	Area Ratio Scaling Factor %	Unit Emission Rate (#/Day)	Unit Emission Rate (#/yr)	24-Hr Scaled Unit Emission Rate (#/hr)	Annual Scaled Unit Emission Rate (#/hr)	24-Hr Area Scaled Emission Rate (#/hr/sq. ft.)	Annual Area Scaled Emission Rate (#/hr/sq. ft.)	24-Hr Area Scaled Emission Rate ($g/s/m^2$)	Annual Area Scaled Emission Rate ($g/s/m^2$)
0	20	2,064,396	100%	1.97E+01	6.64E+03	8.22E-01	7.59E-01	3.98E-07	3.67E-07	0.000000540	0.000000498
0	10	2,064,396	100%	3.68E+00	1.34E+03	1.53E-01	1.53E-01	7.43E-08	7.43E-08	0.000000101	0.000000101
0	10	2,064,396	100%	3.30E+00	1.20E+03	1.37E-01	1.37E-01	6.65E-08	6.65E-08	0.000000090	0.000000090
0	0	2,064,396	100%	4.12E+00	1.40E+03	1.72E-01	1.60E-01	8.31E-08	7.74E-08	0.000000113	0.000000105
0	0	2,064,396	100%	2.06E-01	7.00E+01	8.58E-03	7.99E-03	4.16E-09	3.87E-09	0.000000006	0.000000005
0	14.96	2,064,396	N/A	3.10E+01	1.07E+04	1.29E+00	1.22E+00	6.26E-07	5.90E-07	0.000000849	0.000000800
0	20	3,289,002	65%	5.92E+01	1.99E+04	2.47E+00	2.28E+00	4.90E-07	4.52E-07	0.000000665	0.000000613
0	10	3,289,002	65%	4.31E+00	1.57E+03	1.80E-01	1.80E-01	3.57E-08	3.57E-08	0.000000048	0.000000048
0	0	3,289,002	65%	8.97E+00	3.05E+03	3.74E-01	3.48E-01	7.43E-08	6.92E-08	0.000000101	0.000000094
0	10	3,289,002	65%	3.30E+00	1.20E+03	1.37E-01	1.37E-01	2.73E-08	2.73E-08	0.000000037	0.000000037
0	16.63	3,289,002	N/A	7.57E+01	2.58E+04	3.16E+00	2.94E+00	6.27E-07	5.84E-07	0.000000851	0.000000793
0	20	1,108,040	22%	5.92E+01	1.99E+04	2.47E+00	2.28E+00	4.90E-07	4.52E-07	0.000000665	0.000000613
0	10	1,108,040	22%	4.31E+00	1.57E+03	1.80E-01	1.80E-01	3.57E-08	3.57E-08	0.000000048	0.000000048
0	0	1,108,040	22%	8.97E+00	3.05E+03	3.74E-01	3.48E-01	7.43E-08	6.92E-08	0.000000101	0.000000094
0	10	1,108,040	22%	3.30E+00	1.20E+03	1.37E-01	1.37E-01	2.73E-08	2.73E-08	0.000000037	0.000000037
0	16.63	1,108,040	N/A	7.57E+01	2.58E+04	3.16E+00	2.94E+00	6.27E-07	5.84E-07	0.000000851	0.000000793
0	20	432,133	9%	5.92E+01	1.99E+04	2.47E+00	2.28E+00	4.90E-07	4.52E-07	0.000000665	0.000000613
0	10	432,133	9%	4.31E+00	1.57E+03	1.80E-01	1.80E-01	3.57E-08	3.57E-08	0.000000048	0.000000048
0	0	432,133	9%	8.97E+00	3.05E+03	3.74E-01	3.48E-01	7.43E-08	6.92E-08	0.000000101	0.000000094
0	10	432,133	9%	3.30E+00	1.20E+03	1.37E-01	1.37E-01	2.73E-08	2.73E-08	0.000000037	0.000000037
0	16.63	432,133	N/A	7.57E+01	2.58E+04	3.16E+00	2.94E+00	6.27E-07	5.84E-07	0.000000851	0.000000793
0	20	157,890	3%	5.92E+01	1.99E+04	2.47E+00	2.28E+00	4.90E-07	4.52E-07	0.000000665	0.000000613
0	10	157,890	3%	4.31E+00	1.57E+03	1.80E-01	1.80E-01	3.57E-08	3.57E-08	0.000000048	0.000000048
0	0	157,890	3%	8.97E+00	3.05E+03	3.74E-01	3.48E-01	7.43E-08	6.92E-08	0.000000101	0.000000094
0	10	157,890	3%	3.30E+00	1.20E+03	1.37E-01	1.37E-01	2.73E-08	2.73E-08	0.000000037	0.000000037
0	16.63	157,890	N/A	7.57E+01	2.58E+04	3.16E+00	2.94E+00	6.27E-07	5.84E-07	0.000000851	0.000000793
0	20	44,323	1%	5.92E+01	1.99E+04	2.47E+00	2.28E+00	4.90E-07	4.52E-07	0.000000665	0.000000613
0	10	44,323	1%	4.31E+00	1.57E+03	1.80E-01	1.80E-01	3.57E-08	3.57E-08	0.000000048	0.000000048
0	0	44,323	1%	8.97E+00	3.05E+03	3.74E-01	3.48E-01	7.43E-08	6.92E-08	0.000000101	0.000000094
0	10	44,323	1%	3.30E+00	1.20E+03	1.37E-01	1.37E-01	2.73E-08	2.73E-08	0.000000037	0.000000037
0	16.63	44,323	N/A	7.57E+01	2.58E+04	3.16E+00	2.94E+00	6.27E-07	5.84E-07	0.000000851	0.000000793
0	20	63,158	12%	2.88E+01	9.72E+03	1.20E+00	1.11E+00	2.33E-06	2.15E-06	0.000003161	0.000002918
0	20	63,158	11%	9.62E+00	3.24E+03	4.01E-01	3.70E-01	6.74E-07	6.22E-07	0.000000914	0.000000843
0	20	63,158	12%	5.75E+01	2.11E+04	2.40E+00	2.40E+00	4.49E-06	4.51E-06	0.000006091	0.000006112
0	10	63,158	7%	2.12E+00	7.74E+02	8.83E-02	8.83E-02	9.18E-08	9.18E-08	0.000000125	0.000000125
0	10	63,158	7%	3.50E+00	1.17E+03	1.46E-01	1.34E-01	1.51E-07	1.39E-07	0.000000205	0.000000189
0	10	63,158	7%	3.16E-02	1.12E+01	1.32E-03	1.28E-03	1.37E-09	1.33E-09	0.000000002	0.000000002
0	5	63,158	7%	3.69E+00	1.35E+03	1.54E-01	1.54E-01	1.60E-07	1.60E-07	0.000000217	0.000000217
0	3	63,158	7%	9.66E-02	3.52E+01	4.02E-03	4.02E-03	4.18E-09	4.18E-09	0.000000006	0.000000006
0	19.38	63,158	N/A	1.05E+02	3.74E+04	4.39E+00	4.26E+00	7.90E-06	7.68E-06	0.000010720	0.000010411

Table 2: Imperial Project Model Source Parameters - Area/Line Sources (continued)

Area	Emission Source No.	Emission Source ID	Emission Unit No.	Unit Description	SW Corner Easting (UTM)	Northing (UTM)	Rot. Angle (Deg.)	Base Elevation (ft)	X Length (ft)	Y Length (ft)
Haul Rd 2 (Common)			1.010	Waste Rock Hauling	706386	3650629	-30	820	100	158
			1.011	Ore Hauling	706386	3650629	-30	820	100	158
			1.016	Haul Truck (Combustion)	706386	3650629	-30	820	100	158
			2.005	Grader (Combustion)	706386	3650629	-30	820	100	158
			7.001	Water Truck (Combustion)	706386	3650629	-30	820	100	158
			7.002	Water Truck Traffic	706386	3650629	-30	820	100	158
			8.002	On-Site Light Vehicle Traffic	706386	3650629	-30	820	100	158
			8.006	On-Site Light Vehicle (Combustion)	706386	3650629	-30	820	100	158
	13	HAULRD2	N/A	Sum of Haul Road Sources, Section 2 - Common	706386	3650629	-30	820	100	158
Haul Rd 3 (Common)			1.010	Waste Rock Hauling	706530	3650453	-40	820	100	737
			1.011	Ore Hauling	706530	3650453	-40	820	100	737
			1.016	Haul Truck (Combustion)	706530	3650453	-40	820	100	737
			2.005	Grader (Combustion)	706530	3650453	-40	820	100	737
			7.001	Water Truck (Combustion)	706530	3650453	-40	820	100	737
			7.002	Water Truck Traffic	706530	3650453	-40	820	100	737
			8.002	On-Site Light Vehicle Traffic	706530	3650453	-40	820	100	737
			8.006	On-Site Light Vehicle (Combustion)	706530	3650453	-40	820	100	737
	14	HAULRD3	N/A	Sum of Haul Road Sources, Section 3 - Common	706530	3650453	-40	820	100	737
Haul Rd 4 (Waste)			1.010	Waste Rock Hauling	706450	3650405	31	820	100	263
			1.016	Haul Truck (Combustion)	706450	3650405	31	820	100	263
			2.005	Grader (Combustion)	706450	3650405	31	820	100	263
			7.001	Water Truck (Combustion)	706450	3650405	31	820	100	263
			7.002	Water Truck Traffic	706450	3650405	31	820	100	263
			8.002	On-Site Light Vehicle Traffic	706450	3650405	31	820	100	263
			8.006	On-Site Light Vehicle (Combustion)	706450	3650405	31	820	100	263
	15	HAULRD4	N/A	Sum of Haul Road Sources, Section 4 - Waste	706450	3650405	31	820	100	263
Haul Rd 5 (Waste)			1.010	Waste Rock Hauling	706337	3650260	35	850	100	632
			1.016	Haul Truck (Combustion)	706337	3650260	35	850	100	632
			2.005	Grader (Combustion)	706337	3650260	35	850	100	632
			7.001	Water Truck (Combustion)	706337	3650260	35	850	100	632
			7.002	Water Truck Traffic	706337	3650260	35	850	100	632
			8.002	On-Site Light Vehicle Traffic	706337	3650260	35	850	100	632
			8.006	On-Site Light Vehicle (Combustion)	706337	3650260	35	850	100	632
	16	HAULRD5	N/A	Sum of Haul Road Sources, Section 5 - Waste	706337	3650260	35	850	100	632
Haul Rd 6 (Waste)			1.010	Waste Rock Hauling	706225	3650068	30	900	100	684
			1.016	Haul Truck (Combustion)	706225	3650068	30	900	100	684
			2.005	Grader (Combustion)	706225	3650068	30	900	100	684
			7.001	Water Truck (Combustion)	706225	3650068	30	900	100	684
			7.002	Water Truck Traffic	706225	3650068	30	900	100	684
			8.002	On-Site Light Vehicle Traffic	706225	3650068	30	900	100	684
			8.006	On-Site Light Vehicle (Combustion)	706225	3650068	30	900	100	684
	17	HAULRD6	N/A	Sum of Haul Road Sources, Section 6 - Waste	706225	3650068	30	900	100	684

Table 2: Imperial Project Model Source Parameters - Area/Line Sources (continued)

Release Height (ft)	Plume Height (ft)	Area (Sq.ft)	Area Ratio Scaling Factor %	Unit Emission Rate (#/Day)	Unit Emission Rate (#/yr)	24-Hr Scaled Unit Emission Rate (#/hr)	Annual Scaled Unit Emission Rate (#/hr)	24-Hr Area Scaled Emission Rate (#/sq. ft./hr)	Annual Area Scaled Emission Rate (#/sq. ft./hr)	24-Hr Area Scaled Emission Rate ($g/s/m^2$)	Annual Area Scaled Emission Rate ($g/s/m^2$)
0	20	15,789	3%	2.88E+01	9.72E+03	1.20E+00	1.11E+00	2.33E-06	2.15E-06	0.000003161	0.000002918
0	20	15,789	3%	9.62E+00	3.24E+03	4.01E-01	3.70E-01	6.74E-07	6.22E-07	0.000000914	0.000000843
0	20	15,789	3%	5.75E+01	2.11E+04	2.40E+00	2.40E+00	4.49E-06	4.51E-06	0.000006091	0.000006112
0	10	15,789	2%	2.12E+00	7.74E+02	8.83E-02	8.83E-02	9.18E-08	9.18E-08	0.000000125	0.000000125
0	10	15,789	2%	3.50E+00	1.17E+03	1.46E-01	1.34E-01	1.51E-07	1.39E-07	0.000000205	0.000000189
0	10	15,789	2%	3.16E-02	1.12E+01	1.32E-03	1.28E-03	1.37E-09	1.33E-09	0.000000002	0.000000002
0	5	15,789	2%	3.69E+00	1.35E+03	1.54E-01	1.54E-01	1.60E-07	1.60E-07	0.000000217	0.000000217
0	3	15,789	2%	9.66E-02	3.52E+01	4.02E-03	4.02E-03	4.18E-09	4.18E-09	0.000000006	0.000000006
0	19.38	15,789	N/A	1.05E+02	3.74E+04	4.39E+00	4.26E+00	7.90E-06	7.68E-06	0.000010720	0.000010411
0	20	73,684	14%	2.88E+01	9.72E+03	1.20E+00	1.11E+00	2.33E-06	2.15E-06	0.000003161	0.000002918
0	20	73,684	12%	9.62E+00	3.24E+03	4.01E-01	3.70E-01	6.74E-07	6.22E-07	0.000000914	0.000000843
0	20	73,684	14%	5.75E+01	2.11E+04	2.40E+00	2.40E+00	4.49E-06	4.51E-06	0.000006091	0.000006112
0	10	73,684	8%	2.12E+00	7.74E+02	8.83E-02	8.83E-02	9.18E-08	9.18E-08	0.000000125	0.000000125
0	10	73,684	8%	3.50E+00	1.17E+03	1.46E-01	1.34E-01	1.51E-07	1.39E-07	0.000000205	0.000000189
0	10	73,684	8%	3.16E-02	1.12E+01	1.32E-03	1.28E-03	1.37E-09	1.33E-09	0.000000002	0.000000002
0	5	73,684	8%	3.69E+00	1.35E+03	1.54E-01	1.54E-01	1.60E-07	1.60E-07	0.000000217	0.000000217
0	3	73,684	8%	9.66E-02	3.52E+01	4.02E-03	4.02E-03	4.18E-09	4.18E-09	0.000000006	0.000000006
0	19.38	73,684	N/A	1.05E+02	3.74E+04	4.39E+00	4.26E+00	7.90E-06	7.68E-06	0.000010720	0.000010411
0	20	26,316	5%	2.88E+01	9.72E+03	1.20E+00	1.11E+00	2.33E-06	2.15E-06	0.000003161	0.000002918
0	20	26,316	4%	5.75E+01	2.11E+04	2.40E+00	2.40E+00	3.48E-06	3.50E-06	0.000004725	0.000004741
0	10	26,316	3%	2.12E+00	7.74E+02	8.83E-02	8.83E-02	9.18E-08	9.18E-08	0.000000125	0.000000125
0	10	26,316	3%	3.50E+00	1.17E+03	1.46E-01	1.34E-01	1.51E-07	1.39E-07	0.000000205	0.000000189
0	10	26,316	3%	3.16E-02	1.12E+01	1.32E-03	1.28E-03	1.37E-09	1.33E-09	0.000000002	0.000000002
0	5	26,316	3%	3.69E+00	1.35E+03	1.54E-01	1.54E-01	1.60E-07	1.60E-07	0.000000217	0.000000217
0	3	26,316	3%	9.66E-02	3.52E+01	4.02E-03	4.02E-03	4.18E-09	4.18E-09	0.000000006	0.000000006
0	19.21	26,316	N/A	9.58E+01	3.41E+04	3.99E+00	3.89E+00	6.22E-06	6.04E-06	0.000008440	0.000008196
0	20	63,158	12%	2.88E+01	9.72E+03	1.20E+00	1.11E+00	2.33E-06	2.15E-06	0.000003161	0.000002918
0	20	63,158	9%	5.75E+01	2.11E+04	2.40E+00	2.40E+00	3.48E-06	3.50E-06	0.000004725	0.000004741
0	10	63,158	7%	2.12E+00	7.74E+02	8.83E-02	8.83E-02	9.18E-08	9.18E-08	0.000000125	0.000000125
0	10	63,158	7%	3.50E+00	1.17E+03	1.46E-01	1.34E-01	1.51E-07	1.39E-07	0.000000205	0.000000189
0	10	63,158	7%	3.16E-02	1.12E+01	1.32E-03	1.28E-03	1.37E-09	1.33E-09	0.000000002	0.000000002
0	5	63,158	7%	3.69E+00	1.35E+03	1.54E-01	1.54E-01	1.60E-07	1.60E-07	0.000000217	0.000000217
0	3	63,158	7%	9.66E-02	3.52E+01	4.02E-03	4.02E-03	4.18E-09	4.18E-09	0.000000006	0.000000006
0	19.21	63,158	N/A	9.58E+01	3.41E+04	3.99E+00	3.89E+00	6.22E-06	6.04E-06	0.000008440	0.000008196
0	20	68,421	13%	2.88E+01	9.72E+03	1.20E+00	1.11E+00	2.33E-06	2.15E-06	0.000003161	0.000002918
0	20	68,421	10%	5.75E+01	2.11E+04	2.40E+00	2.40E+00	3.48E-06	3.50E-06	0.000004725	0.000004741
0	10	68,421	7%	2.12E+00	7.74E+02	8.83E-02	8.83E-02	9.18E-08	9.18E-08	0.000000125	0.000000125
0	10	68,421	7%	3.50E+00	1.17E+03	1.46E-01	1.34E-01	1.51E-07	1.39E-07	0.000000205	0.000000189
0	10	68,421	7%	3.16E-02	1.12E+01	1.32E-03	1.28E-03	1.37E-09	1.33E-09	0.000000002	0.000000002
0	5	68,421	7%	3.69E+00	1.35E+03	1.54E-01	1.54E-01	1.60E-07	1.60E-07	0.000000217	0.000000217
0	3	68,421	7%	9.66E-02	3.52E+01	4.02E-03	4.02E-03	4.18E-09	4.18E-09	0.000000006	0.000000006
0	19.21	68,421	N/A	9.58E+01	3.41E+04	3.99E+00	3.89E+00	6.22E-06	6.04E-06	0.000008440	0.000008196

Table 2: Imperial Project Model Source Parameters - Area/Line Sources (continued)

Area	Emission Source No.	Emission Source ID	Emission Unit No.	Unit Description	SW Corner Easting (UTM)	Northing (UTM)	Rot. Angle (Deg.)	Base Elevation (ft)	X Length (ft)	Y Length (ft)
Haul Rd 7 (Waste)			1.010	Waste Rock Hauling	706065	3650020	75	925	100	474
			1.016	Haul Truck (Combustion)	706065	3650020	75	925	100	474
			2.005	Grader (Combustion)	706065	3650020	75	925	100	474
			7.001	Water Truck (Combustion)	706065	3650020	75	925	100	474
			7.002	Water Truck Traffic	706065	3650020	75	925	100	474
			8.002	On-Site Light Vehicle Traffic	706065	3650020	75	925	100	474
			8.006	On-Site Light Vehicle (Combustion)	706065	3650020	75	925	100	474
	18	HAULRD7	N/A	Sum of Haul Road Sources, Section 7 - Waste	706065	3650020	75	925	100	474
Haul Rd 8 (Waste)			1.010	Waste Rock Hauling	705904	3649971	72	950	100	474
			1.016	Haul Truck (Combustion)	705904	3649971	72	950	100	474
			2.005	Grader (Combustion)	705904	3649971	72	950	100	474
			7.001	Water Truck (Combustion)	705904	3649971	72	950	100	474
			7.002	Water Truck Traffic	705904	3649971	72	950	100	474
			8.002	On-Site Light Vehicle Traffic	705904	3649971	72	950	100	474
			8.006	On-Site Light Vehicle (Combustion)	705904	3649971	72	950	100	474
	19	HAULRD8	N/A	Sum of Haul Road Sources, Section 8 - Waste	705904	3649971	72	950	100	474
Haul Rd 9 (Ore)			1.011	Ore Hauling	706573	3650372	150	800	100	368
			1.016	Haul Truck (Combustion)	706573	3650372	150	800	100	368
			2.005	Grader (Combustion)	706573	3650372	150	800	100	368
			7.001	Water Truck (Combustion)	706573	3650372	150	800	100	368
			7.002	Water Truck Traffic	706573	3650372	150	800	100	368
			8.002	On-Site Light Vehicle Traffic	706573	3650372	150	800	100	368
			8.006	On-Site Light Vehicle (Combustion)	706556	3650468	150	800	100	368
	20	HAULRD9	N/A	Sum of Haul Road Sources, Section 9 - Ore	706556	3650468	150	800	100	368
Haul Rd 10 (Ore)			1.011	Ore Hauling	706562	3650285	20	800	100	316
			1.016	Haul Truck (Combustion)	706562	3650285	20	800	100	316
			2.005	Grader (Combustion)	706562	3650285	20	800	100	316
			7.001	Water Truck (Combustion)	706562	3650285	20	800	100	316
			7.002	Water Truck Traffic	706562	3650285	20	800	100	316
			8.001	On-Site Delivery Truck Traffic	706562	3650285	20	800	100	316
			8.002	On-Site Light Vehicle Traffic	706562	3650285	20	800	100	316
			8.005	On-Site Delivery Truck (Combustion)	706562	3650285	20	800	100	316
			8.006	On-Site Light Vehicle (Combustion)	706562	3650285	20	800	100	316
	21	HAULRD10	N/A	Sum of Haul Road Sources, Section 10 - Ore	706562	3650285	20	800	100	316
Haul Rd 11 (Ore)			1.011	Ore Hauling	706482	3650116	20	800	100	684
			1.016	Haul Truck (Combustion)	706482	3650116	20	800	100	684
			2.005	Grader (Combustion)	706482	3650116	20	800	100	684
			7.001	Water Truck (Combustion)	706482	3650116	20	800	100	684
			7.002	Water Truck Traffic	706482	3650116	20	800	100	684
			8.002	On-Site Light Vehicle Traffic	706482	3650116	20	800	100	684
			8.006	On-Site Light Vehicle (Combustion)	706482	3650116	20	800	100	684
	22	HAULRD11	N/A	Sum of Haul Road Sources, Section 11 - Ore	706482	3650116	20	800	100	684

Table 2: Imperial Project Model Source Parameters - Area/Line Sources (continued)

Release Height (ft)	Plume Height (ft)	Area (Sq.ft)	Area Ratio Scaling Factor %	Unit Emission Rate (#/Day)	Unit Emission Rate (#/yr)	24-Hr Scaled Unit Emission Rate (#/hr)	Annual Scaled Unit Emission Rate (#/hr)	24-Hr Area Scaled Emission Rate (#/sq. ft./hr)	Annual Area Scaled Emission Rate (#/sq. ft./hr)	24-Hr Area Scaled Emission Rate ($g/s/m^2$)	Annual Area Scaled Emission Rate ($g/s/m^2$)
0	20	47,368	9%	2.88E+01	9.72E+03	1.20E+00	1.11E+00	2.33E-06	2.15E-06	0.000003161	0.000002918
0	20	47,368	7%	5.75E+01	2.11E+04	2.40E+00	2.40E+00	3.48E-06	3.50E-06	0.000004725	0.000004741
0	10	47,368	5%	2.12E+00	7.74E+02	8.83E-02	8.83E-02	9.18E-08	9.18E-08	0.000000125	0.000000125
0	10	47,368	5%	3.50E+00	1.17E+03	1.46E-01	1.34E-01	1.51E-07	1.39E-07	0.000000205	0.000000189
0	10	47,368	5%	3.16E-02	1.12E+01	1.32E-03	1.28E-03	1.37E-09	1.33E-09	0.000000002	0.000000002
0	5	47,368	5%	3.69E+00	1.35E+03	1.54E-01	1.54E-01	1.60E-07	1.60E-07	0.000000217	0.000000217
0	3	47,368	5%	9.66E-02	3.52E+01	4.02E-03	4.02E-03	4.18E-09	4.18E-09	0.000000006	0.000000006
0	19.21	47,368	N/A	9.58E+01	3.41E+04	3.99E+00	3.89E+00	6.22E-06	6.04E-06	0.000008440	0.000008196
0	20	47,368	9%	2.88E+01	9.72E+03	1.20E+00	1.11E+00	2.33E-06	2.15E-06	0.000003161	0.000002918
0	20	47,368	7%	5.75E+01	2.11E+04	2.40E+00	2.40E+00	3.48E-06	3.50E-06	0.000004725	0.000004741
0	10	47,368	5%	2.12E+00	7.74E+02	8.83E-02	8.83E-02	9.18E-08	9.18E-08	0.000000125	0.000000125
0	10	47,368	5%	3.50E+00	1.17E+03	1.46E-01	1.34E-01	1.51E-07	1.39E-07	0.000000205	0.000000189
0	10	47,368	5%	3.16E-02	1.12E+01	1.32E-03	1.28E-03	1.37E-09	1.33E-09	0.000000002	0.000000002
0	5	47,368	5%	3.69E+00	1.35E+03	1.54E-01	1.54E-01	1.60E-07	1.60E-07	0.000000217	0.000000217
0	3	47,368	5%	9.66E-02	3.52E+01	4.02E-03	4.02E-03	4.18E-09	4.18E-09	0.000000006	0.000000006
0	19.21	47,368	N/A	9.58E+01	3.41E+04	3.99E+00	3.89E+00	6.22E-06	6.04E-06	0.000008440	0.000008196
0	20	36,842	6%	9.62E+00	3.24E+03	4.01E-01	3.70E-01	6.74E-07	6.22E-07	0.000000914	0.000000843
0	20	36,842	2%	5.75E+01	2.11E+04	2.40E+00	2.40E+00	1.01E-06	1.01E-06	0.000001366	0.000001371
0	10	36,842	4%	2.12E+00	7.74E+02	8.83E-02	8.83E-02	9.18E-08	9.18E-08	0.000000125	0.000000125
0	10	36,842	4%	3.50E+00	1.17E+03	1.46E-01	1.34E-01	1.51E-07	1.39E-07	0.000000205	0.000000189
0	10	36,842	4%	3.16E-02	1.12E+01	1.32E-03	1.28E-03	1.37E-09	1.33E-09	0.000000002	0.000000002
0	5	36,842	4%	3.69E+00	1.35E+03	1.54E-01	1.54E-01	1.60E-07	1.60E-07	0.000000217	0.000000217
0	3	36,842	4%	9.66E-02	3.52E+01	4.02E-03	4.02E-03	4.18E-09	4.18E-09	0.000000006	0.000000006
0	17.65	36,842	N/A	7.68E+01	2.76E+04	3.19E+00	3.16E+00	2.09E-06	2.03E-06	0.000002834	0.000002752
0	20	31,579	5%	9.62E+00	3.24E+03	4.01E-01	3.70E-01	6.74E-07	6.22E-07	0.000000914	0.000000843
0	20	31,579	1%	5.75E+01	2.11E+04	2.40E+00	2.40E+00	1.01E-06	1.01E-06	0.000001366	0.000001371
0	10	31,579	3%	2.12E+00	7.74E+02	8.83E-02	8.83E-02	9.18E-08	9.18E-08	0.000000125	0.000000125
0	10	31,579	3%	3.50E+00	1.17E+03	1.46E-01	1.34E-01	1.51E-07	1.39E-07	0.000000205	0.000000189
0	10	31,579	3%	3.16E-02	1.12E+01	1.32E-03	1.28E-03	1.37E-09	1.33E-09	0.000000002	0.000000002
0	10	31,579	22%	2.33E-01	8.49E+01	9.69E-03	9.69E-03	6.64E-08	6.64E-08	0.000000090	0.000000090
0	5	31,579	3%	3.69E+00	1.35E+03	1.54E-01	1.54E-01	1.60E-07	1.60E-07	0.000000217	0.000000217
0	15	31,579	22%	2.63E-03	7.20E-06	1.09E-04	8.22E-10	7.51E-10	5.63E-15	0.000000001	0.000000000
0	3	31,579	3%	9.66E-02	3.52E+01	4.02E-03	4.02E-03	4.18E-09	4.18E-09	0.000000006	0.000000006
0	17.41	31,579	N/A	7.68E+01	2.77E+04	3.20E+00	3.16E+00	2.16E-06	2.10E-06	0.000002925	0.000002842
0	20	68,421	12%	9.62E+00	3.24E+03	4.01E-01	3.70E-01	6.74E-07	6.22E-07	0.000000914	0.000000843
0	20	68,421	3%	5.75E+01	2.11E+04	2.40E+00	2.40E+00	1.01E-06	1.01E-06	0.000001366	0.000001371
0	10	68,421	7%	2.12E+00	7.74E+02	8.83E-02	8.83E-02	9.18E-08	9.18E-08	0.000000125	0.000000125
0	10	68,421	7%	3.50E+00	1.17E+03	1.46E-01	1.34E-01	1.51E-07	1.39E-07	0.000000205	0.000000189
0	10	68,421	7%	3.16E-02	1.12E+01	1.32E-03	1.28E-03	1.37E-09	1.33E-09	0.000000002	0.000000002
0	5	68,421	7%	3.69E+00	1.35E+03	1.54E-01	1.54E-01	1.60E-07	1.60E-07	0.000000217	0.000000217
0	3	68,421	7%	9.66E-02	3.52E+01	4.02E-03	4.02E-03	4.18E-09	4.18E-09	0.000000006	0.000000006
0	17.65	68,421	N/A	7.68E+01	2.76E+04	3.19E+00	3.16E+00	2.09E-06	2.03E-06	0.000002834	0.000002752

Table 2: Imperial Project Model Source Parameters - Area/Line Sources (continued)

Area	Emission Source No.	Emission Source ID	Emission Unit No.	Unit Description	SW Corner Easting (UTM)	Northing (UTM)	Rot. Angle (Deg.)	Base Elevation (ft)	X Length (ft)	Y Length (ft)
Haul Rd 12 (Ore)			1.011	Ore Hauling	706418	3649939	20	800	100	579
			1.016	Haul Truck (Combustion)	706418	3649939	20	800	100	579
			2.005	Grader (Combustion)	706418	3649939	20	800	100	579
			7.001	Water Truck (Combustion)	706418	3649939	20	800	100	579
			7.002	Water Truck Traffic	706418	3649939	20	800	100	579
			8.002	On-Site Light Vehicle Traffic	706418	3649939	20	800	100	579
			8.006	On-Site Light Vehicle (Combustion)	706418	3649939	20	800	100	579
	23	HAULRD12	N/A	Sum of Haul Road Sources, Section 12 - Ore	706418	3649939	20	800	100	579
Haul Rd 13 (Ore)			1.011	Ore Hauling	706386	3649923	55	800	100	105
			2.005	Grader (Combustion)	706386	3649923	55	800	100	105
			7.001	Water Truck (Combustion)	706386	3649923	55	800	100	105
			7.002	Water Truck Traffic	706386	3649923	55	800	100	105
			8.002	On-Site Light Vehicle Traffic	706386	3649923	55	800	100	105
			8.006	On-Site Light Vehicle (Combustion)	706386	3649923	55	800	100	105
	24	HAULRD13	N/A	Sum of Haul Road Sources, Section 13 - Ore	706386	3649923	55	800	100	105
Haul Rd 14 (Ore)			1.011	Ore Hauling	706229	3649812	55	800	100	632
			1.016	Haul Truck (Combustion)	706229	3649812	55	800	100	632
			2.005	Grader (Combustion)	706229	3649812	55	800	100	632
			7.001	Water Truck (Combustion)	706229	3649812	55	800	100	632
			7.002	Water Truck Traffic	706229	3649812	55	800	100	632
			8.002	On-Site Light Vehicle Traffic	706229	3649812	55	800	100	632
			8.006	On-Site Light Vehicle (Combustion)	706229	3649812	55	800	100	632
	25	HAULRD14	N/A	Sum of Haul Road Sources, Section 14 - Ore	706229	3649812	55	800	100	632
Haul Rd 15 (Ore)			1.011	Ore Hauling	706128	3649658	30	800	100	632
			1.016	Haul Truck (Combustion)	706128	3649658	30	800	100	632
			2.005	Grader (Combustion)	706128	3649658	30	800	100	632
			7.001	Water Truck (Combustion)	706128	3649658	30	800	100	632
			7.002	Water Truck Traffic	706128	3649658	30	800	100	632
			8.002	On-Site Light Vehicle Traffic	706128	3649658	30	800	100	632
			8.006	On-Site Light Vehicle (Combustion)	706128	3649658	30	800	100	632
	26	HAULRD15	N/A	Sum of Haul Road Sources, Section 15 - Ore	706128	3649658	30	800	100	632
Delivery Rd 1			2.005	Grader (Combustion)	705010	3649832	30	800	30	300
			7.001	Water Truck (Combustion)	705010	3649832	30	800	30	300
			7.002	Water Truck Traffic	705010	3649832	30	800	30	300
			8.001	On-Site Delivery Truck Traffic	705010	3649832	30	800	30	300
			8.002	On-Site Light Vehicle Traffic	705010	3649832	30	800	30	300
			8.005	On-Site Delivery Truck (Combustion)	705010	3649832	30	800	30	300
			8.006	On-Site Light Vehicle (Combustion)	705010	3649832	30	800	30	300
	27	DELIRD1	N/A	Sum of Delivery Road Sources, Section 1	705010	3649832	30	800	30	300
Delivery Rd 2			2.005	Grader (Combustion)	705083	3649923	119	800	30	300
			7.001	Water Truck (Combustion)	705083	3649923	119	800	30	300
			7.002	Water Truck Traffic	705083	3649923	119	800	30	300
			8.001	On-Site Delivery Truck Traffic	705083	3649923	119	800	30	300
			8.002	On-Site Light Vehicle Traffic	705083	3649923	119	800	30	300
			8.005	On-Site Delivery Truck (Combustion)	705083	3649923	119	800	30	300
			8.006	On-Site Light Vehicle (Combustion)	705083	3649923	119	800	30	300
	28	DELIRD2	N/A	Sum of Delivery Road Sources, Section 2	705083	3649923	119	800	30	300

Table 2: Imperial Project Model Source Parameters - Area/Line Sources (continued)

Release Height (ft)	Plume Height (ft)	Area (Sq.ft)	Area Ratio Scaling Factor %	Unit Emission Rate (#/Day)	Unit Emission Rate (#/yr)	24-Hr Scaled Unit Emission Rate (#/hr)	Annual Scaled Unit Emission Rate (#/hr)	24-Hr Area Scaled Emission Rate (#/sq. ft./hr)	Annual Area Scaled Emission Rate (#/sq. ft./hr)	24-Hr Area Scaled Emission Rate ($g/s/m^2$)	Annual Area Scaled Emission Rate ($g/s/m^2$)
0	20	57,895	10%	9.62E+00	3.24E+03	4.01E-01	3.70E-01	6.74E-07	6.22E-07	0.000000914	0.000000843
0	20	57,895	2%	5.75E+01	2.11E+04	2.40E+00	2.40E+00	1.01E-06	1.01E-06	0.000001366	0.000001371
0	10	57,895	6%	2.12E+00	7.74E+02	8.83E-02	8.83E-02	9.18E-08	9.18E-08	0.000000125	0.000000125
0	10	57,895	6%	3.50E+00	1.17E+03	1.46E-01	1.34E-01	1.51E-07	1.39E-07	0.000000205	0.000000189
0	10	57,895	6%	3.16E-02	1.12E+01	1.32E-03	1.28E-03	1.37E-09	1.33E-09	0.000000002	0.000000002
0	5	57,895	6%	3.69E+00	1.35E+03	1.54E-01	1.54E-01	1.60E-07	1.60E-07	0.000000217	0.000000217
0	3	57,895	6%	9.66E-02	3.52E+01	4.02E-03	4.02E-03	4.18E-09	4.18E-09	0.000000006	0.000000006
0	17.65	57,895	N/A	7.66E+01	2.76E+04	3.19E+00	3.16E+00	2.09E-06	2.03E-06	0.000002834	0.000002752
0	20	10,526	2%	9.62E+00	3.24E+03	4.01E-01	3.70E-01	6.74E-07	6.22E-07	0.000000914	0.000000843
0	10	10,526	1%	2.12E+00	7.74E+02	8.83E-02	8.83E-02	9.18E-08	9.18E-08	0.000000125	0.000000125
0	10	10,526	1%	3.50E+00	1.17E+03	1.46E-01	1.34E-01	1.51E-07	1.39E-07	0.000000205	0.000000189
0	10	10,526	1%	3.16E-02	1.12E+01	1.32E-03	1.28E-03	1.37E-09	1.33E-09	0.000000002	0.000000002
0	5	10,526	1%	3.69E+00	1.35E+03	1.54E-01	1.54E-01	1.60E-07	1.60E-07	0.000000217	0.000000217
0	3	10,526	1%	9.66E-02	3.52E+01	4.02E-03	4.02E-03	4.18E-09	4.18E-09	0.000000006	0.000000006
0	15.46	10,526	N/A	1.91E+01	6.58E+03	7.94E-01	7.51E-01	1.08E-06	1.02E-06	0.000001468	0.000001381
0	20	63,158	11%	9.62E+00	3.24E+03	4.01E-01	3.70E-01	6.74E-07	6.22E-07	0.000000914	0.000000843
0	20	63,158	3%	5.75E+01	2.11E+04	2.40E+00	2.40E+00	1.01E-06	1.01E-06	0.000001366	0.000001371
0	10	63,158	7%	2.12E+00	7.74E+02	8.83E-02	8.83E-02	9.18E-08	9.18E-08	0.000000125	0.000000125
0	10	63,158	7%	3.50E+00	1.17E+03	1.46E-01	1.34E-01	1.51E-07	1.39E-07	0.000000205	0.000000189
0	10	63,158	7%	3.16E-02	1.12E+01	1.32E-03	1.28E-03	1.37E-09	1.33E-09	0.000000002	0.000000002
0	5	63,158	7%	3.69E+00	1.35E+03	1.54E-01	1.54E-01	1.60E-07	1.60E-07	0.000000217	0.000000217
0	3	63,158	7%	9.66E-02	3.52E+01	4.02E-03	4.02E-03	4.18E-09	4.18E-09	0.000000006	0.000000006
0	17.65	63,158	N/A	7.66E+01	2.76E+04	3.19E+00	3.16E+00	2.09E-06	2.03E-06	0.000002834	0.000002752
0	20	63,158	11%	9.62E+00	3.24E+03	4.01E-01	3.70E-01	6.74E-07	6.22E-07	0.000000914	0.000000843
0	20	63,158	3%	5.75E+01	2.11E+04	2.40E+00	2.40E+00	1.01E-06	1.01E-06	0.000001366	0.000001371
0	10	63,158	7%	2.12E+00	7.74E+02	8.83E-02	8.83E-02	9.18E-08	9.18E-08	0.000000125	0.000000125
0	10	63,158	7%	3.50E+00	1.17E+03	1.46E-01	1.34E-01	1.51E-07	1.39E-07	0.000000205	0.000000189
0	10	63,158	7%	3.16E-02	1.12E+01	1.32E-03	1.28E-03	1.37E-09	1.33E-09	0.000000002	0.000000002
0	5	63,158	7%	3.69E+00	1.35E+03	1.54E-01	1.54E-01	1.60E-07	1.60E-07	0.000000217	0.000000217
0	3	63,158	7%	9.66E-02	3.52E+01	4.02E-03	4.02E-03	4.18E-09	4.18E-09	0.000000006	0.000000006
0	17.65	63,158	N/A	7.66E+01	2.76E+04	3.19E+00	3.16E+00	2.09E-06	2.03E-06	0.000002834	0.000002752
0	10	9,000	1%	2.12E+00	7.74E+02	8.83E-02	8.83E-02	9.18E-08	9.18E-08	0.000000125	0.000000125
0	10	9,000	1%	3.50E+00	1.17E+03	1.46E-01	1.34E-01	1.51E-07	1.39E-07	0.000000205	0.000000189
0	10	9,000	1%	3.16E-02	1.12E+01	1.32E-03	1.28E-03	1.37E-09	1.33E-09	0.000000002	0.000000002
0	10	9,000	6%	2.33E-01	8.49E+01	9.69E-03	9.69E-03	6.64E-08	6.64E-08	0.000000090	0.000000090
0	5	9,000	1%	3.69E+00	1.35E+03	1.54E-01	1.54E-01	1.60E-07	1.60E-07	0.000000217	0.000000217
0	15	9,000	6%	2.63E-03	7.20E-06	1.09E-04	8.22E-10	7.51E-10	5.63E-15	0.000000001	0.000000000
0	3	9,000	1%	9.66E-02	3.52E+01	4.02E-03	4.02E-03	4.18E-09	4.18E-09	0.000000006	0.000000006
0	8.27	9,000	N/A	9.67E+00	3.42E+03	4.03E-01	3.91E-01	4.76E-07	4.63E-07	0.000000646	0.000000628
0	10	9,000	1%	2.12E+00	7.74E+02	8.83E-02	8.83E-02	9.18E-08	9.18E-08	0.000000125	0.000000125
0	10	9,000	1%	3.50E+00	1.17E+03	1.46E-01	1.34E-01	1.51E-07	1.39E-07	0.000000205	0.000000189
0	10	9,000	1%	3.16E-02	1.12E+01	1.32E-03	1.28E-03	1.37E-09	1.33E-09	0.000000002	0.000000002
0	10	9,000	6%	2.33E-01	8.49E+01	9.69E-03	9.69E-03	6.64E-08	6.64E-08	0.000000090	0.000000090
0	5	9,000	1%	3.69E+00	1.35E+03	1.54E-01	1.54E-01	1.60E-07	1.60E-07	0.000000217	0.000000217
0	15	9,000	6%	2.63E-03	7.20E-06	1.09E-04	8.22E-10	7.51E-10	5.63E-15	0.000000001	0.000000000
0	3	9,000	1%	9.66E-02	3.52E+01	4.02E-03	4.02E-03	4.18E-09	4.18E-09	0.000000006	0.000000006
0	8.27	9,000	N/A	9.67E+00	3.42E+03	4.03E-01	3.91E-01	4.76E-07	4.63E-07	0.000000646	0.000000628

Table 2: Imperial Project Model Source Parameters - Area/Line Sources (continued)

Area	Emission Source No.	Emission Source ID	Emission Unit No.	Unit Description	SW Corner Easting (UTM)	Northing (UTM)	Rot. Angle (Deg.)	Base Elevation (ft)	X Length (ft)	Y Length (ft)
Delivery Rd 3			2.005	Grader (Combustion)	705240	3649830	119	800	30	300
			7.001	Water Truck (Combustion)	705240	3649830	119	800	30	300
			7.002	Water Truck Traffic	705240	3649830	119	800	30	300
			8.001	On-Site Delivery Truck Traffic	705240	3649830	119	800	30	300
			8.002	On-Site Light Vehicle Traffic	705240	3649830	119	800	30	300
			8.005	On-Site Delivery Truck (Combustion)	705240	3649830	119	800	30	300
			8.006	On-Site Light Vehicle (Combustion)	705240	3649830	119	800	30	300
	29	DELIRD3	N/A	Sum of Delivery Road Sources, Section 3	705240	3649830	119	800	30	300
Delivery Rd 4			2.005	Grader (Combustion)	705407	3649734	119	800	30	300
			7.001	Water Truck (Combustion)	705407	3649734	119	800	30	300
			7.002	Water Truck Traffic	705407	3649734	119	800	30	300
			8.001	On-Site Delivery Truck Traffic	705407	3649734	119	800	30	300
			8.002	On-Site Light Vehicle Traffic	705407	3649734	119	800	30	300
			8.005	On-Site Delivery Truck (Combustion)	705407	3649734	119	800	30	300
			8.006	On-Site Light Vehicle (Combustion)	705407	3649734	119	800	30	300
	30	DELIRD4	N/A	Sum of Delivery Road Sources, Section 4	705407	3649734	119	800	30	300
Delivery Rd 5			2.005	Grader (Combustion)	705544	3649641	50	800	30	300
			7.001	Water Truck (Combustion)	705544	3649641	50	800	30	300
			7.002	Water Truck Traffic	705544	3649641	50	800	30	300
			8.001	On-Site Delivery Truck Traffic	705544	3649641	50	800	30	300
			8.002	On-Site Light Vehicle Traffic	705544	3649641	50	800	30	300
			8.005	On-Site Delivery Truck (Combustion)	705544	3649641	50	800	30	300
			8.006	On-Site Light Vehicle (Combustion)	705544	3649641	50	800	30	300
	31	DELIRD5	N/A	Sum of Delivery Road Sources, Section 5	705544	3649641	50	800	30	300
Delivery Rd 6			2.005	Grader (Combustion)	705690	3649761	50	800	30	300
			7.001	Water Truck (Combustion)	705690	3649761	50	800	30	300
			7.002	Water Truck Traffic	705690	3649761	50	800	30	300
			8.001	On-Site Delivery Truck Traffic	705690	3649761	50	800	30	300
			8.002	On-Site Light Vehicle Traffic	705690	3649761	50	800	30	300
			8.005	On-Site Delivery Truck (Combustion)	705690	3649761	50	800	30	300
			8.006	On-Site Light Vehicle (Combustion)	705690	3649761	50	800	30	300
	32	DELIRD6	N/A	Sum of Delivery Road Sources, Section 6	705690	3649761	50	800	30	300
Delivery Rd 7			2.005	Grader (Combustion)	705825	3649872	88	800	30	300
			7.001	Water Truck (Combustion)	705825	3649872	88	800	30	300
			7.002	Water Truck Traffic	705825	3649872	88	800	30	300
			8.001	On-Site Delivery Truck Traffic	705825	3649872	88	800	30	300
			8.002	On-Site Light Vehicle Traffic	705825	3649872	88	800	30	300
			8.005	On-Site Delivery Truck (Combustion)	705825	3649872	88	800	30	300
			8.006	On-Site Light Vehicle (Combustion)	705825	3649872	88	800	30	300
	33	DELIRD7	N/A	Sum of Delivery Road Sources, Section 7	705825	3649872	88	800	30	300
Delivery Rd 8			2.005	Grader (Combustion)	705987	3649879	64	800	30	300
			7.001	Water Truck (Combustion)	705987	3649879	64	800	30	300
			7.002	Water Truck Traffic	705987	3649879	64	800	30	300
			8.001	On-Site Delivery Truck Traffic	705987	3649879	64	800	30	300
			8.002	On-Site Light Vehicle Traffic	705987	3649879	64	800	30	300
			8.005	On-Site Delivery Truck (Combustion)	705987	3649879	64	800	30	300
			8.006	On-Site Light Vehicle (Combustion)	705987	3649879	64	800	30	300
	34	DELIRD8	N/A	Sum of Delivery Road Sources, Section 8	705987	3649879	64	800	30	300

Table 2: Imperial Project Model Source Parameters - Area/Line Sources (continued)

Release Height (ft)	Plume Height (ft)	Area (Sq.ft)	Area Ratio Scaling Factor %	Unit Emission Rate (#/Day)	Unit Emission Rate (#/yr)	24-Hr Scaled Unit Emission Rate (#/hr)	Annual Scaled Unit Emission Rate (#/hr)	24-Hr Area Scaled Emission Rate (#/sq. ft./hr)	Annual Area Scaled Emission Rate (#/sq. ft./hr)	24-Hr Area Scaled Emission Rate ($g/s/m^2$)	Annual Area Scaled Emission Rate ($g/s/m^2$)
0	10	9,000	1%	2.12E+00	7.74E+02	8.83E-02	8.83E-02	9.18E-08	9.18E-08	0.000000125	0.000000125
0	10	9,000	1%	3.50E+00	1.17E+03	1.46E-01	1.34E-01	1.51E-07	1.39E-07	0.000000205	0.000000189
0	10	9,000	1%	3.16E-02	1.12E+01	1.32E-03	1.28E-03	1.37E-09	1.33E-09	0.000000002	0.000000002
0	10	9,000	6%	2.33E-01	8.49E+01	9.69E-03	9.69E-03	6.64E-08	6.64E-08	0.000000090	0.000000090
0	5	9,000	1%	3.69E+00	1.35E+03	1.54E-01	1.54E-01	1.60E-07	1.60E-07	0.000000217	0.000000217
0	15	9,000	6%	2.63E-03	7.20E-06	1.09E-04	8.22E-10	7.51E-10	5.63E-15	0.000000001	0.000000000
0	3	9,000	1%	9.66E-02	3.52E+01	4.02E-03	4.02E-03	4.18E-09	4.18E-09	0.000000006	0.000000006
0	8.27	9,000	N/A	9.67E+00	3.42E+03	4.03E-01	3.91E-01	4.76E-07	4.63E-07	0.000000646	0.000000628
0	10	9,000	1%	2.12E+00	7.74E+02	8.83E-02	8.83E-02	9.18E-08	9.18E-08	0.000000125	0.000000125
0	10	9,000	1%	3.50E+00	1.17E+03	1.46E-01	1.34E-01	1.51E-07	1.39E-07	0.000000205	0.000000189
0	10	9,000	1%	3.16E-02	1.12E+01	1.32E-03	1.28E-03	1.37E-09	1.33E-09	0.000000002	0.000000002
0	10	9,000	6%	2.33E-01	8.49E+01	9.69E-03	9.69E-03	6.64E-08	6.64E-08	0.000000090	0.000000090
0	5	9,000	1%	3.69E+00	1.35E+03	1.54E-01	1.54E-01	1.60E-07	1.60E-07	0.000000217	0.000000217
0	15	9,000	6%	2.63E-03	7.20E-06	1.09E-04	8.22E-10	7.51E-10	5.63E-15	0.000000001	0.000000000
0	3	9,000	1%	9.66E-02	3.52E+01	4.02E-03	4.02E-03	4.18E-09	4.18E-09	0.000000006	0.000000006
0	8.27	9,000	N/A	9.67E+00	3.42E+03	4.03E-01	3.91E-01	4.76E-07	4.63E-07	0.000000646	0.000000628
0	10	9,000	1%	2.12E+00	7.74E+02	8.83E-02	8.83E-02	9.18E-08	9.18E-08	0.000000125	0.000000125
0	10	9,000	1%	3.50E+00	1.17E+03	1.46E-01	1.34E-01	1.51E-07	1.39E-07	0.000000205	0.000000189
0	10	9,000	1%	3.16E-02	1.12E+01	1.32E-03	1.28E-03	1.37E-09	1.33E-09	0.000000002	0.000000002
0	10	9,000	6%	2.33E-01	8.49E+01	9.69E-03	9.69E-03	6.64E-08	6.64E-08	0.000000090	0.000000090
0	5	9,000	1%	3.69E+00	1.35E+03	1.54E-01	1.54E-01	1.60E-07	1.60E-07	0.000000217	0.000000217
0	15	9,000	6%	2.63E-03	7.20E-06	1.09E-04	8.22E-10	7.51E-10	5.63E-15	0.000000001	0.000000000
0	3	9,000	1%	9.66E-02	3.52E+01	4.02E-03	4.02E-03	4.18E-09	4.18E-09	0.000000006	0.000000006
0	8.27	9,000	N/A	9.67E+00	3.42E+03	4.03E-01	3.91E-01	4.76E-07	4.63E-07	0.000000646	0.000000628
0	10	9,000	1%	2.12E+00	7.74E+02	8.83E-02	8.83E-02	9.18E-08	9.18E-08	0.000000125	0.000000125
0	10	9,000	1%	3.50E+00	1.17E+03	1.46E-01	1.34E-01	1.51E-07	1.39E-07	0.000000205	0.000000189
0	10	9,000	1%	3.16E-02	1.12E+01	1.32E-03	1.28E-03	1.37E-09	1.33E-09	0.000000002	0.000000002
0	10	9,000	6%	2.33E-01	8.49E+01	9.69E-03	9.69E-03	6.64E-08	6.64E-08	0.000000090	0.000000090
0	5	9,000	1%	3.69E+00	1.35E+03	1.54E-01	1.54E-01	1.60E-07	1.60E-07	0.000000217	0.000000217
0	15	9,000	6%	2.63E-03	7.20E-06	1.09E-04	8.22E-10	7.51E-10	5.63E-15	0.000000001	0.000000000
0	3	9,000	1%	9.66E-02	3.52E+01	4.02E-03	4.02E-03	4.18E-09	4.18E-09	0.000000006	0.000000006
0	8.27	9,000	N/A	9.67E+00	3.42E+03	4.03E-01	3.91E-01	4.76E-07	4.63E-07	0.000000646	0.000000628
0	10	9,000	1%	2.12E+00	7.74E+02	8.83E-02	8.83E-02	9.18E-08	9.18E-08	0.000000125	0.000000125
0	10	9,000	1%	3.50E+00	1.17E+03	1.46E-01	1.34E-01	1.51E-07	1.39E-07	0.000000205	0.000000189
0	10	9,000	1%	3.16E-02	1.12E+01	1.32E-03	1.28E-03	1.37E-09	1.33E-09	0.000000002	0.000000002
0	10	9,000	6%	2.33E-01	8.49E+01	9.69E-03	9.69E-03	6.64E-08	6.64E-08	0.000000090	0.000000090
0	5	9,000	1%	3.69E+00	1.35E+03	1.54E-01	1.54E-01	1.60E-07	1.60E-07	0.000000217	0.000000217
0	15	9,000	6%	2.63E-03	7.20E-06	1.09E-04	8.22E-10	7.51E-10	5.63E-15	0.000000001	0.000000000
0	3	9,000	1%	9.66E-02	3.52E+01	4.02E-03	4.02E-03	4.18E-09	4.18E-09	0.000000006	0.000000006
0	8.27	9,000	N/A	9.67E+00	3.42E+03	4.03E-01	3.91E-01	4.76E-07	4.63E-07	0.000000646	0.000000628

Table 2: Imperial Project Model Source Parameters - Area/Line Sources (continued)

Area	Emission Source No.	Emission Source ID	Emission Unit No.	Unit Description	SW Corner Easting (UTM)	Northing (UTM)	Rot. Angle (Deg.)	Base Elevation (ft)	X Length (ft)	Y Length (ft)
Delivery Rd 9			2.005	Grader (Combustion)	706146	3649953	64	800	30	300
			7.001	Water Truck (Combustion)	706146	3649953	64	800	30	300
			7.002	Water Truck Traffic	706146	3649953	64	800	30	300
			8.001	On-Site Delivery Truck Traffic	706146	3649953	64	800	30	300
			8.002	On-Site Light Vehicle Traffic	706146	3649953	64	800	30	300
			8.005	On-Site Delivery Truck (Combustion)	706146	3649953	64	800	30	300
			8.006	On-Site Light Vehicle (Combustion)	706146	3649953	64	800	30	300
	35	DELIRD9	N/A	Sum of Delivery Road Sources, Section 9	706146	3649953	64	800	30	300
Delivery Rd 10			2.005	Grader (Combustion)	706303	3650027	30	800	30	300
			7.001	Water Truck (Combustion)	706303	3650027	30	800	30	300
			7.002	Water Truck Traffic	706303	3650027	30	800	30	300
			8.001	On-Site Delivery Truck Traffic	706303	3650027	30	800	30	300
			8.002	On-Site Light Vehicle Traffic	706303	3650027	30	800	30	300
			8.005	On-Site Delivery Truck (Combustion)	706303	3650027	30	800	30	300
			8.006	On-Site Light Vehicle (Combustion)	706303	3650027	30	800	30	300
	36	DELIRD10	N/A	Sum of Delivery Road Sources, Section 10	706303	3650027	30	800	30	300
Delivery Rd 11			2.005	Grader (Combustion)	706400	3650194	30	800	30	300
			7.001	Water Truck (Combustion)	706400	3650194	30	800	30	300
			7.002	Water Truck Traffic	706400	3650194	30	800	30	300
			8.001	On-Site Delivery Truck Traffic	706400	3650194	30	800	30	300
			8.002	On-Site Light Vehicle Traffic	706400	3650194	30	800	30	300
			8.005	On-Site Delivery Truck (Combustion)	706400	3650194	30	800	30	300
			8.006	On-Site Light Vehicle (Combustion)	706400	3650194	30	800	30	300
	37	DELIRD11	N/A	Sum of Delivery Road Sources, Section 11	706400	3650194	30	800	30	300
Delivery Rd 12			2.005	Grader (Combustion)	706464	3650308	29	800	30	300
			7.001	Water Truck (Combustion)	706464	3650308	29	800	30	300
			7.002	Water Truck Traffic	706464	3650308	29	800	30	300
			8.001	On-Site Delivery Truck Traffic	706464	3650308	29	800	30	300
			8.002	On-Site Light Vehicle Traffic	706464	3650308	29	800	30	300
			8.005	On-Site Delivery Truck (Combustion)	706464	3650308	29	800	30	300
			8.006	On-Site Light Vehicle (Combustion)	706464	3650308	29	800	30	300
	38	DELIRD12	N/A	Sum of Delivery Road Sources, Section 12	706464	3650308	29	800	30	300
Delivery Rd 13			2.005	Grader (Combustion)	706528	3650420	110	800	30	211
			7.001	Water Truck (Combustion)	706528	3650420	110	800	30	211
			7.002	Water Truck Traffic	706528	3650420	110	800	30	211
			8.001	On-Site Delivery Truck Traffic	706528	3650420	110	800	30	211
			8.002	On-Site Light Vehicle Traffic	706528	3650420	110	800	30	211
			8.005	On-Site Delivery Truck (Combustion)	706528	3650420	110	800	30	211
			8.006	On-Site Light Vehicle (Combustion)	706528	3650420	110	800	30	211
	39	DELIRD13	N/A	Sum of Delivery Road Sources, Section 13	706528	3650420	110	800	30	211
Lime Application	40	LIMEAPPL	2.003	Lime Application to Ore	706555	3650237	30	800	5	10
Lime Hopper Load	41	LIMEHOPP	2.002	Portable R-O-M Lime Hopper Loading	706571	3650231	30	800	3	3
AN Silo	42	ANSILOUN	1.013	Ammonium Nitrate Prill Silo Unloading	706590	3650227	0	800	3	3

Table 2: Imperial Project Model Source Parameters - Area/Line Sources (continued)

Release Height (ft)	Plume Height (ft)	Area (Sq.ft)	Area Ratio Scaling Factor %	Unit Emission Rate (#/Day)	Unit Emission Rate (#/yr)	24-Hr Scaled Unit Emission Rate (#/hr)	Annual Scaled Unit Emission Rate (#/hr)	24-Hr Area Scaled Emission Rate (#/sq. ft./hr)	Annual Area Scaled Emission Rate (#/sq. ft./hr)	24-Hr Area Scaled Emission Rate ($g/s/m^2$)	Annual Area Scaled Emission Rate ($g/s/m^2$)
0	10	9,000	1%	2.12E+00	7.74E+02	8.83E-02	8.83E-02	9.18E-08	9.18E-08	0.000000125	0.000000125
0	10	9,000	1%	3.50E+00	1.17E+03	1.46E-01	1.34E-01	1.51E-07	1.39E-07	0.000000205	0.000000189
0	10	9,000	1%	3.16E-02	1.12E+01	1.32E-03	1.28E-03	1.37E-09	1.33E-09	0.000000002	0.000000002
0	10	9,000	6%	2.33E-01	8.49E+01	9.69E-03	9.69E-03	6.64E-08	6.64E-08	0.000000090	0.000000090
0	5	9,000	1%	3.69E+00	1.35E+03	1.54E-01	1.54E-01	1.60E-07	1.60E-07	0.000000217	0.000000217
0	15	9,000	6%	2.63E-03	7.20E-06	1.09E-04	8.22E-10	7.51E-10	5.63E-15	0.000000001	0.000000000
0	3	9,000	1%	9.66E-02	3.52E+01	4.02E-03	4.02E-03	4.18E-09	4.18E-09	0.000000006	0.000000006
0	8.27	9,000	N/A	9.67E+00	3.42E+03	4.03E-01	3.91E-01	4.76E-07	4.63E-07	0.000000646	0.000000628
0	10	9,000	1%	2.12E+00	7.74E+02	8.83E-02	8.83E-02	9.18E-08	9.18E-08	0.000000125	0.000000125
0	10	9,000	1%	3.50E+00	1.17E+03	1.46E-01	1.34E-01	1.51E-07	1.39E-07	0.000000205	0.000000189
0	10	9,000	1%	3.16E-02	1.12E+01	1.32E-03	1.28E-03	1.37E-09	1.33E-09	0.000000002	0.000000002
0	10	9,000	6%	2.33E-01	8.49E+01	9.69E-03	9.69E-03	6.64E-08	6.64E-08	0.000000090	0.000000090
0	5	9,000	1%	3.69E+00	1.35E+03	1.54E-01	1.54E-01	1.60E-07	1.60E-07	0.000000217	0.000000217
0	15	9,000	6%	2.63E-03	7.20E-06	1.09E-04	8.22E-10	7.51E-10	5.63E-15	0.000000001	0.000000000
0	3	9,000	1%	9.66E-02	3.52E+01	4.02E-03	4.02E-03	4.18E-09	4.18E-09	0.000000006	0.000000006
0	8.27	9,000	N/A	9.67E+00	3.42E+03	4.03E-01	3.91E-01	4.76E-07	4.63E-07	0.000000646	0.000000628
0	10	9,000	1%	2.12E+00	7.74E+02	8.83E-02	8.83E-02	9.18E-08	9.18E-08	0.000000125	0.000000125
0	10	9,000	1%	3.50E+00	1.17E+03	1.46E-01	1.34E-01	1.51E-07	1.39E-07	0.000000205	0.000000189
0	10	9,000	1%	3.16E-02	1.12E+01	1.32E-03	1.28E-03	1.37E-09	1.33E-09	0.000000002	0.000000002
0	10	9,000	6%	2.33E-01	8.49E+01	9.69E-03	9.69E-03	6.64E-08	6.64E-08	0.000000090	0.000000090
0	5	9,000	1%	3.69E+00	1.35E+03	1.54E-01	1.54E-01	1.60E-07	1.60E-07	0.000000217	0.000000217
0	15	9,000	6%	2.63E-03	7.20E-06	1.09E-04	8.22E-10	7.51E-10	5.63E-15	0.000000001	0.000000000
0	3	9,000	1%	9.66E-02	3.52E+01	4.02E-03	4.02E-03	4.18E-09	4.18E-09	0.000000006	0.000000006
0	8.27	9,000	N/A	9.67E+00	3.42E+03	4.03E-01	3.91E-01	4.76E-07	4.63E-07	0.000000646	0.000000628
0	10	9,000	1%	2.12E+00	7.74E+02	8.83E-02	8.83E-02	9.18E-08	9.18E-08	0.000000125	0.000000125
0	10	9,000	1%	3.50E+00	1.17E+03	1.46E-01	1.34E-01	1.51E-07	1.39E-07	0.000000205	0.000000189
0	10	9,000	1%	3.16E-02	1.12E+01	1.32E-03	1.28E-03	1.37E-09	1.33E-09	0.000000002	0.000000002
0	10	9,000	6%	2.33E-01	8.49E+01	9.69E-03	9.69E-03	6.64E-08	6.64E-08	0.000000090	0.000000090
0	5	9,000	1%	3.69E+00	1.35E+03	1.54E-01	1.54E-01	1.60E-07	1.60E-07	0.000000217	0.000000217
0	15	9,000	6%	2.63E-03	7.20E-06	1.09E-04	8.22E-10	7.51E-10	5.63E-15	0.000000001	0.000000000
0	3	9,000	1%	9.66E-02	3.52E+01	4.02E-03	4.02E-03	4.18E-09	4.18E-09	0.000000006	0.000000006
0	8.27	9,000	N/A	9.67E+00	3.42E+03	4.03E-01	3.91E-01	4.76E-07	4.63E-07	0.000000646	0.000000628
0	10	6,316	1%	2.12E+00	7.74E+02	8.83E-02	8.83E-02	9.18E-08	9.18E-08	0.000000125	0.000000125
0	10	6,316	1%	3.50E+00	1.17E+03	1.46E-01	1.34E-01	1.51E-07	1.39E-07	0.000000205	0.000000189
0	10	6,316	1%	3.16E-02	1.12E+01	1.32E-03	1.28E-03	1.37E-09	1.33E-09	0.000000002	0.000000002
0	10	6,316	4%	2.33E-01	8.49E+01	9.69E-03	9.69E-03	6.64E-08	6.64E-08	0.000000090	0.000000090
0	5	6,316	1%	3.69E+00	1.35E+03	1.54E-01	1.54E-01	1.60E-07	1.60E-07	0.000000217	0.000000217
0	15	6,316	4%	2.63E-03	7.20E-06	1.09E-04	8.22E-10	7.51E-10	5.63E-15	0.000000001	0.000000000
0	3	6,316	1%	9.66E-02	3.52E+01	4.02E-03	4.02E-03	4.18E-09	4.18E-09	0.000000006	0.000000006
0	8.27	6,316	N/A	9.67E+00	3.42E+03	4.03E-01	3.91E-01	4.76E-07	4.63E-07	0.000000646	0.000000628
0	20	50	100%	3.65E-02	1.23E+01	1.52E-03	1.40E-03	3.04E-05	2.81E-05	0.000041282	0.000038106
0	20	9	100%	6.50E-01	2.19E+02	2.71E-02	2.50E-02	3.01E-03	2.78E-03	0.004081316	0.003767369
0	10	9	100%	1.49E-01	5.48E+01	6.20E-03	6.25E-03	6.88E-04	6.94E-04	0.000933554	0.000941842

Table 3: Imperial Project Model Source Parameters - Open Pit Sources

Area	Emission Source No.	Emission Source ID	Emission Unit No.	Unit Description	SW Corner Easting (UTM)	Northing (UTM)	Rot. Angle (Deg.)	Base Elevation (ft)	X Length (ft)	Y Length (ft)
West Pit			1.001	Drilling - Waste Rock	705777	3651283	30	820	1909	1909
			1.002	Drilling - Ore	705777	3651283	30	820	1909	1909
			1.003	Blasting - Waste Rock	705777	3651283	30	820	1909	1909
			1.004	Blasting - Ore	705777	3651283	30	820	1909	1909
			1.005	Waste Rock Loading	705777	3651283	30	820	1909	1909
			1.006	Ore Loading	705777	3651283	30	820	1909	1909
			1.010	Waste Rock Hauling	705777	3651283	30	820	1909	1909
			1.011	Ore Hauling	705777	3651283	30	820	1909	1909
			1.016	Haul Truck (Combustion)	705777	3651283	30	820	1909	1909
			1.018	Drill Rig (Combustion)	705777	3651283	30	820	1909	1909
			1.019	Loader (Combustion)	705777	3651283	30	820	1909	1909
			1.020	Clean-Up Loader (Combustion)	705777	3651283	30	820	1909	1909
			2.005	Grader (Combustion)	705777	3651283	30	820	1909	1909
			7.001	Water Truck (Combustion)	705777	3651283	30	820	1909	1909
			7.002	Water Truck Traffic	705777	3651283	30	820	1909	1909
			8.002	On-Site Light Vehicle Traffic	705777	3651283	30	820	1909	1909
			8.006	On-Site Light Vehicle (Combustion)	705777	3651283	30	820	1909	1909
	43	WESTPIT	N/A	Sum of Pit Sources	705777	3651283	30	820	1909	1909

Table 3: Imperial Project Model Source Parameters - Open Pit Sources (Continued)

Release Height (ft)	Area Ratio Factor %	Area (Sq.ft)	Pit Volume (Cu.ft)	Unit Emission Rate (#/Day)	Unit Emission Rate (#/yr)	24-Hr Scaled Unit Emission Rate (#/hr)	Annual Scaled Unit Emission Rate (#/hr)	24-Hr Area Scaled Emission Rate (#/sq. ft./hr)	Annual Area Scaled Emission Rate (#/sq. ft./hr)	24-Hr Area Scaled Emission Rate ($g/s/m^2$)	Annual Area Scaled Emission Rate ($g/s/m^2$)
0	100%	3.64E+06	2.19E+09	2.63E+00	9.70E+02	1.10E-01	1.11E-01	3.01E-08	3.04E-08	4.082E-08	4.120E-08
0	100%	3.64E+06	2.19E+09	8.78E-01	3.23E+02	3.66E-02	3.69E-02	1.00E-08	1.01E-08	1.361E-08	1.373E-08
0	100%	3.64E+06	2.19E+09	2.50E+01	1.97E+03	1.04E+00	2.25E-01	2.86E-07	6.18E-08	3.877E-07	8.383E-08
0	100%	3.64E+06	2.19E+09	0.00E+00	6.58E+02	0.00E+00	7.51E-02	0.00E+00	2.06E-08	0.000E+00	2.794E-08
0	100%	3.64E+06	2.19E+09	2.40E+01	8.10E+03	1.00E+00	9.24E-01	2.75E-07	2.54E-07	3.726E-07	3.439E-07
0	100%	3.64E+06	2.19E+09	8.01E+00	2.70E+03	3.34E-01	3.08E-01	9.16E-08	8.45E-08	1.242E-07	1.146E-07
0	21%	3.64E+06	2.19E+09	2.88E+01	9.72E+03	1.20E+00	1.11E+00	7.07E-08	6.52E-08	9.584E-08	8.847E-08
0	19%	3.64E+06	2.19E+09	9.62E+00	3.24E+03	4.01E-01	3.70E-01	2.04E-08	1.89E-08	2.771E-08	2.558E-08
0	21%	3.64E+06	2.19E+09	5.75E+01	2.11E+04	2.40E+00	2.40E+00	1.36E-07	1.37E-07	1.847E-07	1.853E-07
0	100%	3.64E+06	2.19E+09	1.99E+01	7.38E+03	8.30E-01	8.42E-01	2.28E-07	2.31E-07	3.090E-07	3.134E-07
0	100%	3.64E+06	2.19E+09	8.21E+00	3.00E+03	3.42E-01	3.42E-01	9.38E-08	9.38E-08	1.272E-07	1.272E-07
0	100%	3.64E+06	2.19E+09	2.18E+00	7.94E+02	9.07E-02	9.07E-02	2.49E-08	2.49E-08	3.374E-08	3.374E-08
0	11%	3.64E+06	2.19E+09	2.12E+00	7.74E+02	8.83E-02	8.83E-02	2.78E-09	2.78E-09	3.776E-09	3.776E-09
0	11%	3.64E+06	2.19E+09	3.50E+00	1.17E+03	1.46E-01	1.34E-01	4.59E-09	4.22E-09	6.229E-09	5.721E-09
0	11%	3.64E+06	2.19E+09	3.16E-02	1.12E+01	1.32E-03	1.28E-03	4.16E-11	4.03E-11	5.637E-11	5.467E-11
0	11%	3.64E+06	2.19E+09	3.69E+00	1.35E+03	1.54E-01	1.54E-01	4.85E-09	4.85E-09	6.578E-09	6.578E-09
0	11%	3.64E+06	2.19E+09	9.66E-02	3.52E+01	4.02E-03	4.02E-03	1.27E-10	1.27E-10	1.721E-10	1.721E-10
20	N/A	3.64E+06	2.19E+09	1.96E+02	6.32E+04	8.18E+00	7.22E+00	1.28E-06	1.04E-06	1.734E-06	1.415E-06

This page intentionally left blank
for reproduction purposes.

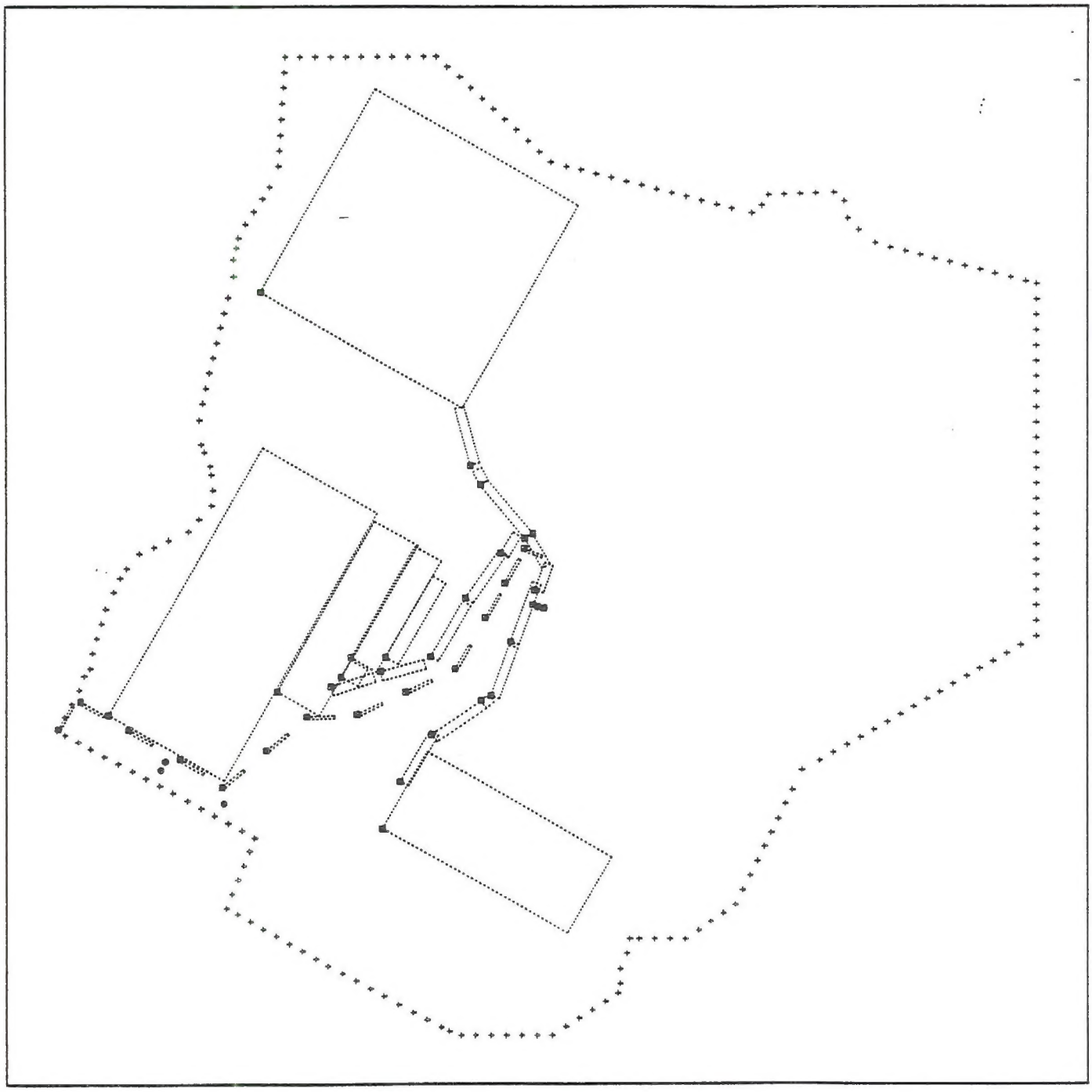
APPENDIX K

PLATES

PLATE 1

IMPERIAL PROJECT PM-10 IMPACT ASSESSMENT

Source & Discrete (Boundary) Receptor Locations

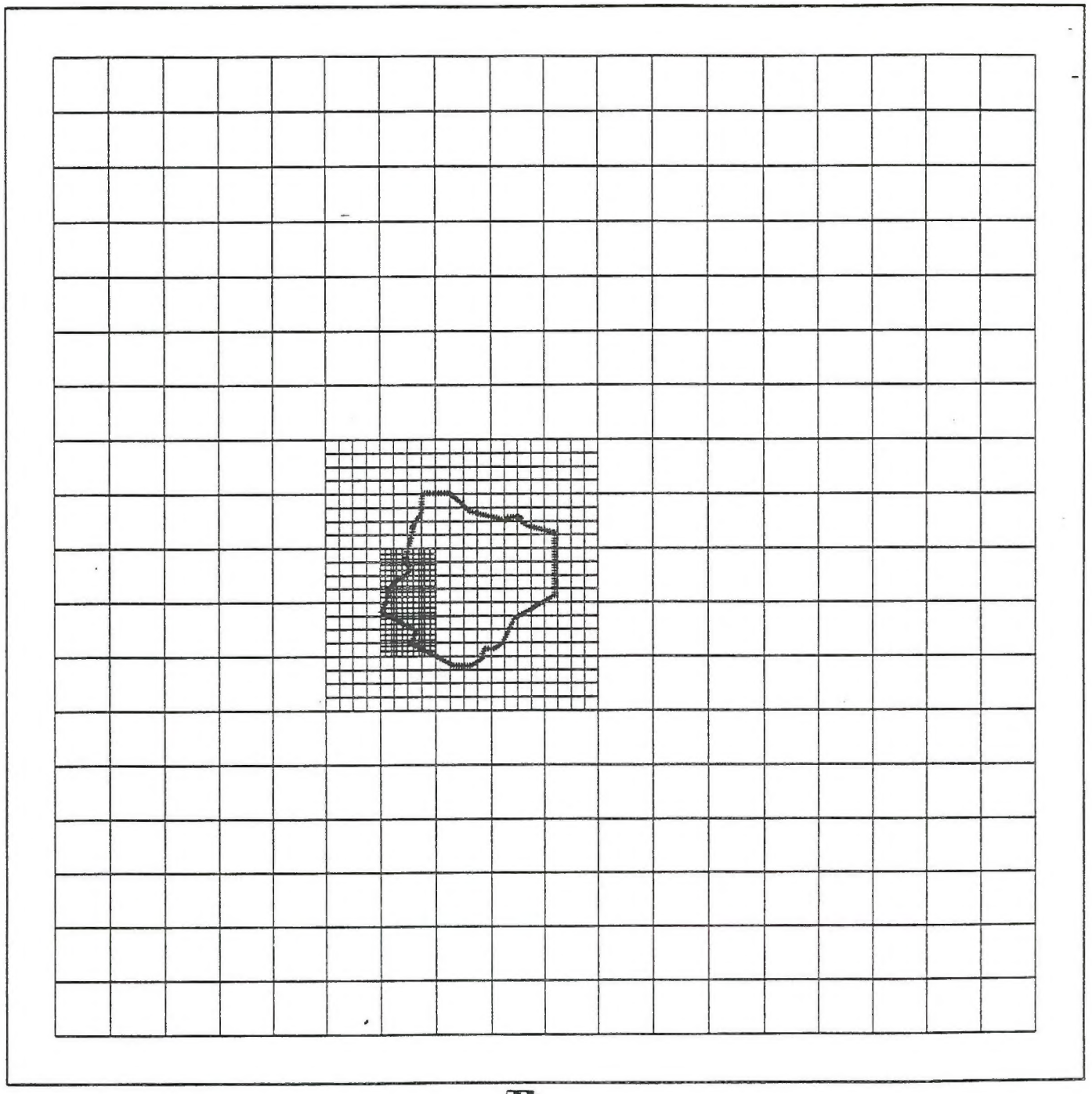


500 METERS

PLATE 2

IMPERIAL PROJECT PM-10 IMPACT ASSESSMENT

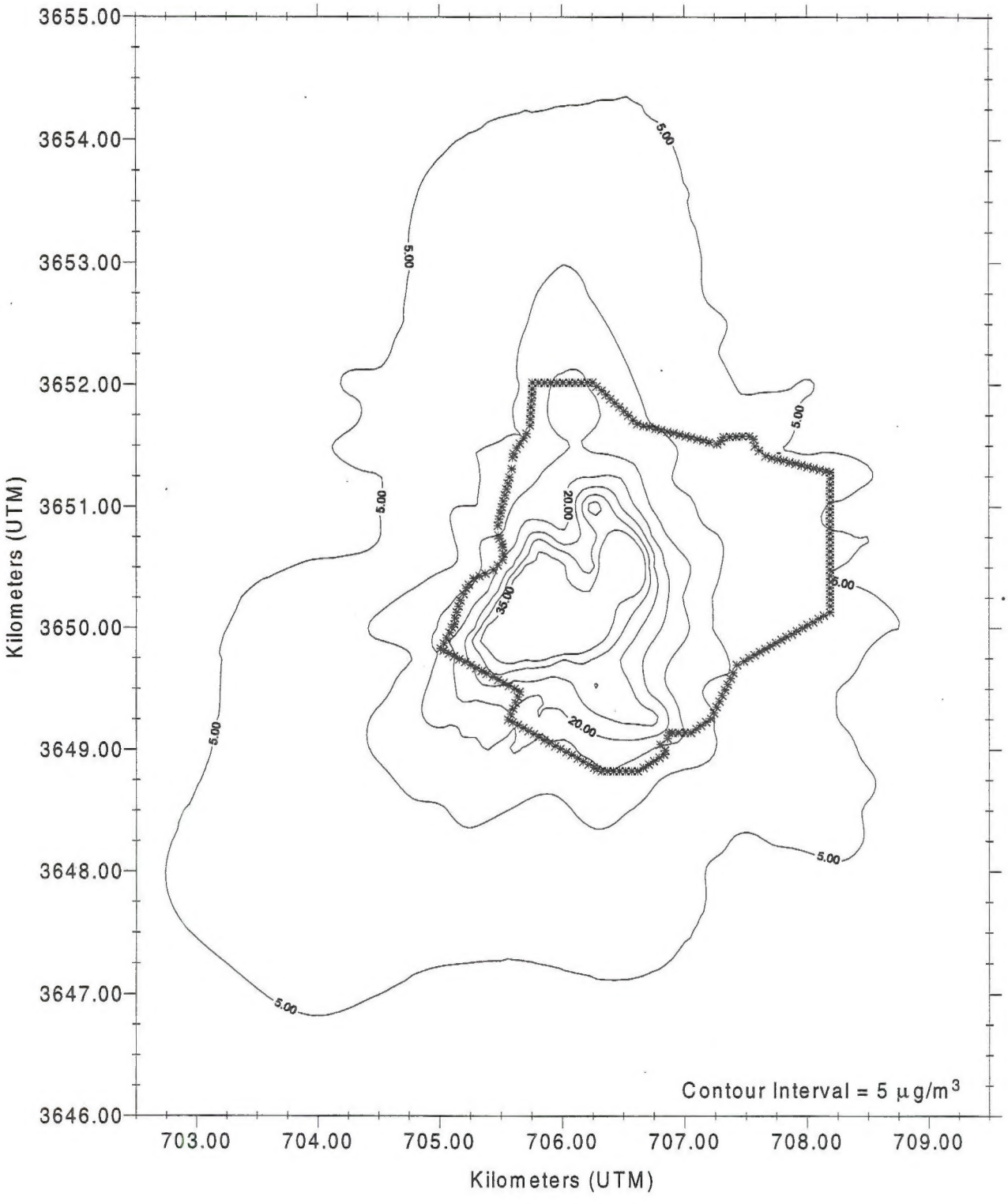
1000 M/250 M/100 M Grids & Discrete (Boundary) Receptor Locations



500 METERS

PLATE 3

24-Hr Average Ambient PM_{10} Concentrations in Micrograms per Cubic Meter ($\mu g/m^3$)
Combined Results - 1000 m/250 m/100 m Grids & Discrete Receptors



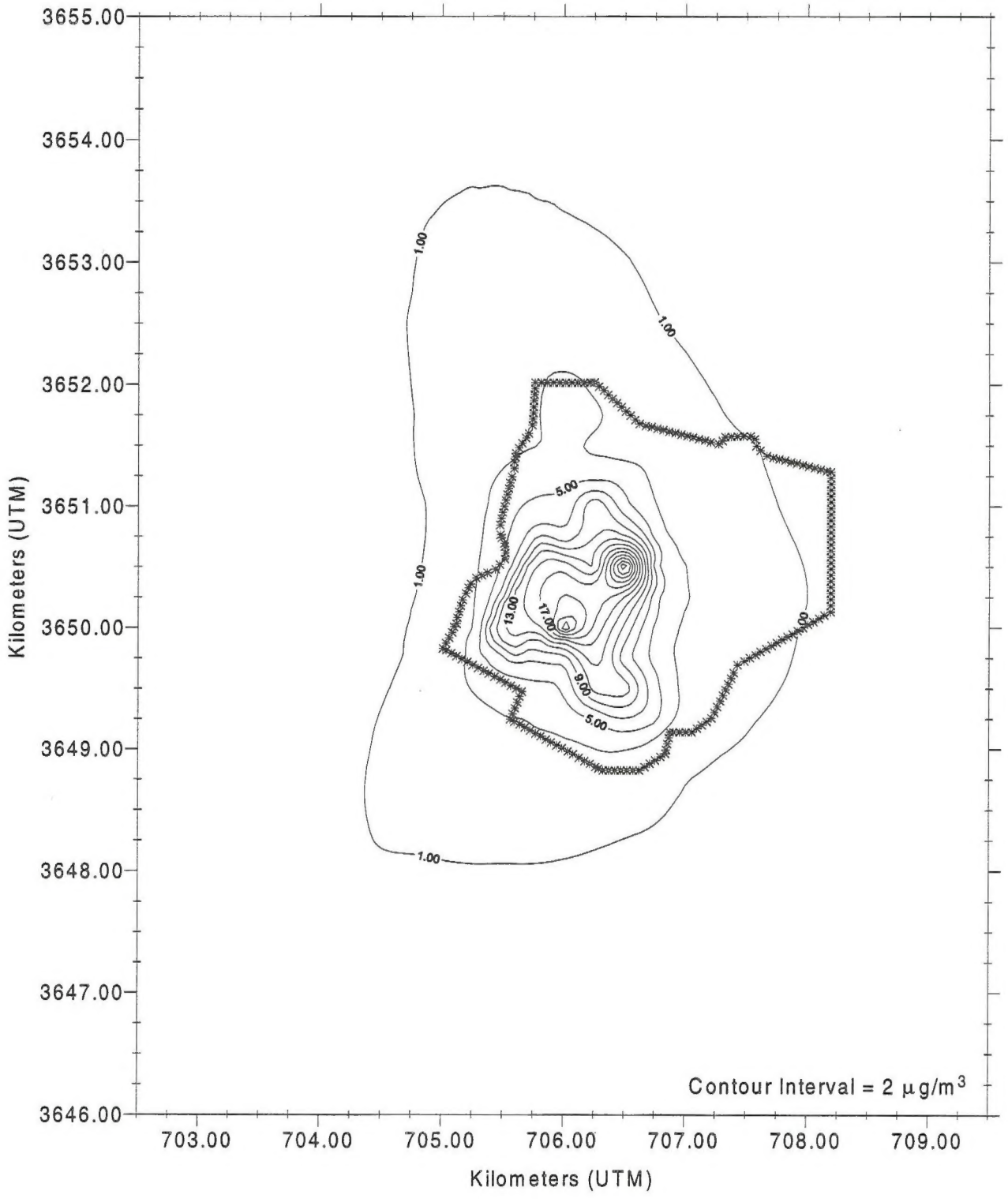
Scale 1" = 1.25 Kilometer

0.00 1.00 2.00 3.00 4.00

095924HR.SRF

PLATE 4

Average Annual Ambient PM_{10} Concentrations in Micrograms per Cubic Meter ($\mu g/m^3$)
Combined Results - 1000 m/250 m/100 m Grids & Discrete Receptors



Scale 1" = 1.25 Kilometer

0.00 1.00 2.00 3.00 4.00

0959ANNU.SRF

APPENDIX L

U.S. EPA INDUSTRIAL SOURCE COMPLEX - SHORT TERM (ISCST3) DISPERSION MODELING RESULTS

APPENDIX L-1

Maximum 24-Hour PM_{10} Concentrations
1000 and 250 Meter Screening Grids With Discrete (Boundary) Receptors

```
1                    ISCST3 - (DATED 96113)

               IBM-PC VERSION [3.00]   ISCST3R
      (C) COPYRIGHT 1992-1996, TRINITY CONSULTANTS, INC.

 Run Began on  8/08/1996 at 16:23:03


 ** BREEZE AIR ISCST3 - C:\TRINITY\0959XI36.DAT
 ** Trinity Consultants Incorporated, Dallas, TX

 CO STARTING
 CO TITLEONE  IMPERIAL PROJECT PM-10 IMPACT ASSESSMENT
 CO TITLETWO  24-HR IMPACTS - 1000 M/250 M GRIDS & DISCRETE (FENCELINE) RECEPTORS
 CO MODELOPT  DFAULT  CONC  RURAL
 CO AVERTIME  24
 CO POLLUTID  PM10
 CO TERRHGTS  ELEV
 CO RUNORNOT  RUN
 CO SAVEFILE  SAVE1.FIL  5  C:\TRINITY\0959XI36.SV2
 CO ERRORFIL  ERROR.LST
 CO FINISHED

 SO STARTING
 SO ELEVUNIT  METERS
 SO LOCATION  ANSILOLD  POINT  706591.0  3650227.0  243.84
 SO LOCATION  LIMELOAD  POINT  706572.0  3650230.0  243.84
 SO LOCATION  JAWCRUSH  POINT  705358.0  3649725.0  231.65
 SO LOCATION  PULVERIZ  POINT  705344.0  3649697.0  231.65
 SO LOCATION  DIESGENR  POINT  705549.0  3649588.0  231.65
 SO LOCATION  HEAPAREA  AREA  706070.0  3649505.0  274.32
 SO LOCATION  WASTESP1  AREA  705324.0  3649918.0  289.56
 SO LOCATION  WASTESP2  AREA  705727.0  3649955.0  289.56
 SO LOCATION  WASTESP3  AREA  705969.0  3650067.0  289.56
 SO LOCATION  WASTESP4  AREA  706081.0  3650067.0  289.56
 SO LOCATION  WASTESP5  AREA  705936.0  3650003.0  289.56
 SO LOCATION  HAULRD1  AREA  706354.0  3650693.0  249.94
 SO LOCATION  HAULRD2  AREA  706386.0  3650629.0  249.94
 SO LOCATION  HAULRD3  AREA  706530.0  3650453.0  249.94
 SO LOCATION  HAULRD4  AREA  706450.0  3650405.0  249.94
 SO LOCATION  HAULRD5  AREA  706337.0  3650260.0  259.08
 SO LOCATION  HAULRD6  AREA  706225.0  3650068.0  274.32
 SO LOCATION  HAULRD7  AREA  706065.0  3650020.0  281.94
 SO LOCATION  HAULRD8  AREA  705904.0  3649971.0  289.56
 SO LOCATION  HAULRD9  AREA  706556.0  3650468.0  243.84
 SO LOCATION  HAULRD10  AREA  706562.0  3650285.0  243.84
 SO LOCATION  HAULRD11  AREA  706482.0  3650116.0  243.84
 SO LOCATION  HAULRD12  AREA  706418.0  3649939.0  243.84
 SO LOCATION  HAULRD13  AREA  706386.0  3649923.0  243.84
 SO LOCATION  HAULRD14  AREA  706229.0  3649812.0  243.84
 SO LOCATION  HAULRD15  AREA  706128.0  3649658.0  243.84
 SO LOCATION  DELIRD1  AREA  705010.0  3649832.0  243.84
 SO LOCATION  DELIRD2  AREA  705083.0  3649923.0  243.84
 SO LOCATION  DELIRD3  AREA  705240.0  3649830.0  243.84
 SO LOCATION  DELIRD4  AREA  705407.0  3649734.0  243.84
 SO LOCATION  DELIRD5  AREA  705544.0  3649641.0  243.84
 SO LOCATION  DELIRD6  AREA  705690.0  3649761.0  243.84
 SO LOCATION  DELIRD7  AREA  705825.0  3649872.0  243.84
 SO LOCATION  DELIRD8  AREA  705987.0  3649879.0  243.84
 SO LOCATION  DELIRD9  AREA  706146.0  3649953.0  243.84
 SO LOCATION  DELIRD10  AREA  706303.0  3650027.0  243.84
 SO LOCATION  DELIRD11  AREA  706400.0  3650194.0  243.84
 SO LOCATION  DELIRD12  AREA  706464.0  3650308.0  243.84
 SO LOCATION  DELIRD13  AREA  706528.0  3650420.0  243.84
 SO LOCATION  LIMEAPPL  AREA  706555.0  3650237.0  243.84
 SO LOCATION  LIMEHOPP  AREA  706571.0  3650231.0  243.84
 SO LOCATION  ANSILOUN  AREA  706590.0  3650227.0  243.84
 SO LOCATION  WESTPIT  OPENPIT  705777.0  3651283.0  249.94
 SO SRCPARAM  ANSILOLD  1.31250000E-03  22.16  299.81  8.17  0.20
 SO SRCPARAM  LIMELOAD  3.54375000E-04  22.16  299.81  8.17  0.20
 SO SRCPARAM  JAWCRUSH  3.80181000E-04  4.57  299.81  0.01  1.83
 SO SRCPARAM  PULVERIZ  3.80181000E-04  1.52  299.81  0.01  1.83
 SO SRCPARAM  DIESGENR  0.00000000E+00  3.05  322.04  21.34  0.20
 SO SRCPARAM  HEAPAREA  8.49186000E-07  0.00  700.00  273.98  30.0  4.56
 SO SRCPARAM  WASTESP1  8.51000000E-07  0.00  333.33  916.69  30.0  4.92
 SO SRCPARAM  WASTESP2  8.51000000E-07  0.00  160.42  641.68  30.0  4.92
 SO SRCPARAM  WASTESP3  8.51000000E-07  0.00  96.25  417.09  30.0  4.92
 SO SRCPARAM  WASTESP4  8.51000000E-07  0.00  48.12  304.80  30.0  4.92
 SO SRCPARAM  WASTESP5  8.51000000E-07  0.00  64.17  64.17  30.0  4.92
 SO SRCPARAM  HAULRD1  1.07201000E-05  0.00  30.48  192.51  -15.0  5.91
 SO SRCPARAM  HAULRD2  1.07201000E-05  0.00  30.48  48.12  -30.0  5.91
 SO SRCPARAM  HAULRD3  1.07201000E-05  0.00  30.48  224.59  -40.0  5.91
 SO SRCPARAM  HAULRD4  8.44041000E-06  0.00  30.48  80.21  31.0  5.86
 SO SRCPARAM  HAULRD5  8.44041000E-06  0.00  30.48  192.51  35.0  5.86
 SO SRCPARAM  HAULRD6  8.44041000E-06  0.00  30.48  208.55  30.0  5.86
 SO SRCPARAM  HAULRD7  8.44041000E-06  0.00  30.48  144.38  75.0  5.86
 SO SRCPARAM  HAULRD8  8.44041000E-06  0.00  30.48  144.38  72.0  5.86
 SO SRCPARAM  HAULRD9  2.83416000E-06  0.00  30.48  112.29  150.0  5.38
 SO SRCPARAM  HAULRD10  2.92525000E-06  0.00  30.48  96.25  20.0  5.31
 SO SRCPARAM  HAULRD11  2.83416000E-06  0.00  30.48  208.55  20.0  5.38
 SO SRCPARAM  HAULRD12  2.83416000E-06  0.00  30.48  176.46  20.0  5.38
 SO SRCPARAM  HAULRD13  1.46821000E-06  0.00  30.48  32.08  55.0  4.71
 SO SRCPARAM  HAULRD14  2.83416000E-06  0.00  30.48  192.51  55.0  5.38
 SO SRCPARAM  HAULRD15  2.83416000E-06  0.00  30.48  192.51  30.0  5.38
 SO SRCPARAM  DELIRD1  6.45552000E-07  0.00  9.14  91.40  30.0  2.52
 SO SRCPARAM  DELIRD2  6.45552000E-07  0.00  9.14  91.40  119.0  2.52
```



```
 SO SRCPARAM  DELIRD3  6.45552000E-07  0.00  9.14  91.40  119.0  2.52
 SO SRCPARAM  DELIRD4  6.45552000E-07  0.00  9.14  91.40  119.0  2.52
 SO SRCPARAM  DELIRD5  6.45552000E-07  0.00  9.14  91.40  50.0  2.52
 SO SRCPARAM  DELIRD6  6.45552000E-07  0.00  9.14  91.40  50.0  2.52
 SO SRCPARAM  DELIRD7  6.45552000E-07  0.00  9.14  91.40  88.0  2.52
 SO SRCPARAM  DELIRD8  6.45552000E-07  0.00  9.14  91.40  64.0  2.52
 SO SRCPARAM  DELIRD9  6.45552000E-07  0.00  9.14  91.40  64.0  2.52
 SO SRCPARAM  DELIRD10  6.45552000E-07  0.00  9.14  91.40  30.0  2.52
 SO SRCPARAM  DELIRD11  6.45552000E-07  0.00  9.14  91.40  30.0  2.52
 SO SRCPARAM  DELIRD12  6.45552000E-07  0.00  9.14  91.40  29.0  2.52
 SO SRCPARAM  DELIRD13  6.45552000E-07  0.00  9.14  64.17  110.0  2.52
 SO SRCPARAM  LIMEAPPL  4.12819000E-05  0.00  1.52  3.05  30.0  6.10
 SO SRCPARAM  LIMEHOPP  4.08131600E-03  0.00  0.91  0.91  30.0  6.10
 SO SRCPARAM  ANSILOUN  9.33554000E-04  0.00  0.91  0.91  0.0  3.05
 SO SRCPARAM  WESTPIT  1.73397000E-06  6.00  581.86  581.86  62100000.0  30.0
 SO PARTDIAM  WESTPIT  10
 SO MASSFRAX  WESTPIT  1
 SO PARTDENS  WESTPIT  2.5
 SO CONCUNIT  1.00E+06  GRAMS/SEC  MICROGRAMS/M**3
 SO SRCGROUP  ALL
 SO FINISHED

 RE STARTING
 RE ELEVUNIT  FEET
 RE GRIDCART CART1 STA
 RE GRIDCART CART1 XYINC  699000  19  1000  3642000  19  1000
 RE GRIDCART CART1 ELEV  1  535.0  530.0  560.7  613.0  698.3  977.3  1007.0
 RE GRIDCART CART1 ELEV  1  1468.5  1558.3  996.0  862.0  821.0  291.0  264.0
 RE GRIDCART CART1 ELEV  1  224.0  210.0  193.0  203.0  204.0
 RE GRIDCART CART1 ELEV  2  541.0  552.2  593.8  634.3  703.9  994.8  985.7
 RE GRIDCART CART1 ELEV  2  1315.5  1227.5  940.3  922.2  980.2  340.7  278.5
 RE GRIDCART CART1 ELEV  2  215.8  201.0  210.0  215.0  211.0
 RE GRIDCART CART1 ELEV  3  554.3  573.0  610.8  657.7  742.6  824.7  817.3
 RE GRIDCART CART1 ELEV  3  859.0  950.1  834.3  866.9  873.6  276.3  236.2
 RE GRIDCART CART1 ELEV  3  218.2  207.7  216.4  225.6  225.0
 RE GRIDCART CART1 ELEV  4  576.0  592.0  618.7  665.0  729.0  757.7  758.0
 RE GRIDCART CART1 ELEV  4  800.8  882.7  900.0  856.0  851.3  240.0  233.7
 RE GRIDCART CART1 ELEV  4  220.0  219.0  228.3  246.0  257.0
 RE GRIDCART CART1 ELEV  5  583.0  603.6  626.6  663.0  677.7  705.4  737.0
 RE GRIDCART CART1 ELEV  5  753.4  781.0  826.0  819.2  816.4  238.3  226.2
 RE GRIDCART CART1 ELEV  5  225.0  234.0  237.2  256.4  257.0
 RE GRIDCART CART1 ELEV  6  592.0  624.0  636.0  636.7  655.0  670.2  703.7
 RE GRIDCART CART1 ELEV  6  722.0  731.4  762.3  772.4  780.8  246.0  244.2
 RE GRIDCART CART1 ELEV  6  237.2  247.7  246.8  255.4  264.7
 RE GRIDCART CART1 ELEV  7  644.0  644.3  653.3  668.0  679.7  694.7  705.0
 RE GRIDCART CART1 ELEV  7  729.8  731.7  755.0  772.0  806.7  254.0  255.3
 RE GRIDCART CART1 ELEV  7  253.7  254.0  258.0  267.7  276.0
 RE GRIDCART CART1 ELEV  8  632.3  671.6  670.4  697.7  702.4  729.0  729.3
 RE GRIDCART CART1 ELEV  8  744.0  755.2  767.0  786.8  786.5  262.3  274.2
 RE GRIDCART CART1 ELEV  8  259.2  275.3  281.8  285.1  302.7
 RE GRIDCART CART1 ELEV  9  678.3  708.6  727.1  708.7  765.0  766.8  784.7
 RE GRIDCART CART1 ELEV  9  767.8  776.5  793.0  797.4  813.8  256.0  267.2
 RE GRIDCART CART1 ELEV  9  287.8  257.7  245.2  249.5  281.0
 RE GRIDCART CART1 ELEV  10  691.0  734.3  750.0  767.0  790.3  856.7  860.0
 RE GRIDCART CART1 ELEV  10  821.7  822.0  812.0  832.7  861.3  247.0  226.7
 RE GRIDCART CART1 ELEV  10  258.7  237.0  221.7  220.7  243.0
 RE GRIDCART CART1 ELEV  11  708.0  733.4  803.2  778.3  836.2  899.6  881.7
 RE GRIDCART CART1 ELEV  11  834.3  832.8  871.7  874.2  896.5  264.7  238.2
 RE GRIDCART CART1 ELEV  11  232.0  202.3  217.0  234.9  285.0
 RE GRIDCART CART1 ELEV  12  723.3  738.4  756.6  785.3  880.4  942.0  895.0
 RE GRIDCART CART1 ELEV  12  869.8  885.2  908.0  958.7  937.2  288.0  253.5
 RE GRIDCART CART1 ELEV  12  198.8  217.7  199.5  177.7  192.7
 RE GRIDCART CART1 ELEV  13  770.0  781.3  799.7  821.0  864.7  863.3  990.0
 RE GRIDCART CART1 ELEV  13  941.0  926.3  948.0  977.3  1036.8  364.0  343.0
 RE GRIDCART CART1 ELEV  13  300.3  199.0  161.0  196.0  153.0
 RE GRIDCART CART1 ELEV  14  780.0  792.0  833.8  873.0  920.3  973.5  943.3
 RE GRIDCART CART1 ELEV  14  998.9  940.3  1031.3  1043.4  1064.9  351.7  287.3
 RE GRIDCART CART1 ELEV  14  251.7  210.0  165.0  168.8  153.0
 RE GRIDCART CART1 ELEV  15  817.3  853.6  858.0  927.0  1021.1  1029.2  1062.3
 RE GRIDCART CART1 ELEV  15  1056.0  1114.8  1055.7  854.2  770.7  222.7  212.4
 RE GRIDCART CART1 ELEV  15  214.1  179.7  188.5  105.4  170.3
 RE GRIDCART CART1 ELEV  16  858.0  907.7  903.3  927.0  1066.7  1463.7  1397.0
 RE GRIDCART CART1 ELEV  16  1558.3  1179.7  1222.0  992.0  1298.7  256.0  237.7
 RE GRIDCART CART1 ELEV  16  164.7  169.0  125.0  157.7  139.0
 RE GRIDCART CART1 ELEV  17  893.3  934.0  1033.3  1347.7  1484.2  1762.1  1702.0
 RE GRIDCART CART1 ELEV  17  1413.1  1193.4  1271.7  1157.1  951.0  308.3  208.3
 RE GRIDCART CART1 ELEV  17  198.1  132.7  102.0  125.3  93.3
 RE GRIDCART CART1 ELEV  18  1127.0  1056.1  1073.0  1344.0  1980.0  1647.8  1286.7
 RE GRIDCART CART1 ELEV  18  1076.2  1312.5  1163.3  978.2  778.5  293.3  176.2
 RE GRIDCART CART1 ELEV  18  147.0  121.0  116.7  90.6  62.0
 RE GRIDCART CART1 ELEV  19  1184.0  1148.3  1469.7  1862.0  1526.3  1248.3  1136.0
 RE GRIDCART CART1 ELEV  19  1095.3  954.0  881.0  725.3  620.5  195.0  156.7
 RE GRIDCART CART1 ELEV  19  134.3  114.0  87.0  65.3  59.0
 RE GRIDCART CART1 END
 RE GRIDCART CART2 STA
 RE GRIDCART CART2 XYINC  704000  21  250  3648000  21  250
 RE GRIDCART CART2 ELEV  1  694.7  702.0  697.3  707.0  705.0  704.0  713.0
 RE GRIDCART CART2 ELEV  1  700.0  729.8  733.7  716.0  727.0  731.7  733.0
 RE GRIDCART CART2 ELEV  1  741.7  747.3  755.0  765.0  768.0  765.0  772.0
 RE GRIDCART CART2 ELEV  2  700.2  706.3  702.3  710.6  710.0  711.0  716.0
 RE GRIDCART CART2 ELEV  2  731.3  727.4  729.4  729.3  736.4  740.2  734.3
 RE GRIDCART CART2 ELEV  2  747.4  751.4  755.7  752.6  764.0  770.0  778.0
 RE GRIDCART CART2 ELEV  3  708.6  715.0  712.3  710.7  711.3  729.3  722.5
 RE GRIDCART CART2 ELEV  3  730.3  729.0  731.6  732.0  739.6  744.2  741.0
 RE GRIDCART CART2 ELEV  3  754.5  760.4  765.3  762.8  767.6  771.3  777.4
 RE GRIDCART CART2 ELEV  4  716.0  721.0  705.3  720.0  731.0  720.3  725.0
```

```
RE GRIDCART CART2 ELEV  4  729.0  737.0  740.3  740.0  747.0  751.0  753.0
RE GRIDCART CART2 ELEV  4  762.0  761.0  766.0  768.3  776.0  779.0  785.0
RE GRIDCART CART2 ELEV  5  729.0  730.7  717.6  724.4  729.3  728.8  733.2
RE GRIDCART CART2 ELEV  5  738.0  744.0  746.4  746.0  751.2  755.2  745.0
RE GRIDCART CART2 ELEV  5  759.6  763.8  767.0  772.0  778.0  781.0  786.8
RE GRIDCART CART2 ELEV  6  735.7  730.7  727.4  732.2  733.0  732.8  736.8
RE GRIDCART CART2 ELEV  6  742.7  748.4  750.8  750.7  755.6  759.8  773.3
RE GRIDCART CART2 ELEV  6  765.2  770.2  774.3  781.4  785.6  789.7  795.4
RE GRIDCART CART2 ELEV  7  737.7  738.0  741.3  759.3  738.0  739.3  744.0
RE GRIDCART CART2 ELEV  7  753.0  755.0  766.0  742.0  756.7  759.3  773.0
RE GRIDCART CART2 ELEV  7  767.0  772.7  777.0  787.0  791.0  795.0  803.0
RE GRIDCART CART2 ELEV  8  739.4  740.3  746.2  770.3  741.7  743.2  749.2
RE GRIDCART CART2 ELEV  8  758.3  767.9  773.9  775.0  771.1  764.7  769.0
RE GRIDCART CART2 ELEV  8  779.4  785.4  790.7  785.1  797.5  793.0  815.6
RE GRIDCART CART2 ELEV  9  766.8  736.3  745.6  756.7  784.7  762.3  758.0
RE GRIDCART CART2 ELEV  9  766.7  767.8  772.0  772.0  776.6  776.5  780.0
RE GRIDCART CART2 ELEV  9  788.0  790.6  793.0  815.1  806.0  806.7  797.4
RE GRIDCART CART2 ELEV 10  817.0  747.0  747.3  758.3  779.0  767.0  772.3
RE GRIDCART CART2 ELEV 10  778.0  777.0  778.7  779.0  783.0  783.3  784.0
RE GRIDCART CART2 ELEV 10  791.3  792.7  794.0  793.7  807.0  807.0  809.0
RE GRIDCART CART2 ELEV 11  835.6  766.0  776.2  772.2  775.7  783.0  799.4
RE GRIDCART CART2 ELEV 11  792.3  785.5  782.1  780.7  783.8  783.5  781.7
RE GRIDCART CART2 ELEV 11  795.8  790.9  793.3  796.8  812.6  816.0  821.0
RE GRIDCART CART2 ELEV 12  853.0  794.0  785.0  794.0  772.0  780.6  778.8
RE GRIDCART CART2 ELEV 12  805.3  797.4  794.4  783.0  795.7  812.7  792.0
RE GRIDCART CART2 ELEV 12  813.8  816.7  812.3  800.4  814.4  819.3  825.6
RE GRIDCART CART2 ELEV 13  856.7  782.0  783.3  860.3  860.0  787.0  778.3
RE GRIDCART CART2 ELEV 13  806.0  821.7  821.0  804.0  788.0  822.0  800.0
RE GRIDCART CART2 ELEV 13  810.0  809.7  812.0  813.3  826.0  829.0  832.7
RE GRIDCART CART2 ELEV 14  866.1  823.7  856.4  789.9  873.3  808.3  786.2
RE GRIDCART CART2 ELEV 14  807.0  826.3  830.2  803.0  811.6  823.4  828.3
RE GRIDCART CART2 ELEV 14  824.0  814.6  818.3  823.2  836.8  829.0  828.6
RE GRIDCART CART2 ELEV 15  863.6  829.3  883.0  799.0  898.3  857.4  851.9
RE GRIDCART CART2 ELEV 15  819.7  823.8  847.7  816.3  812.0  823.8  842.3
RE GRIDCART CART2 ELEV 15  846.1  832.6  823.3  827.0  857.0  856.0  846.4
RE GRIDCART CART2 ELEV 16  889.3  832.0  908.0  866.7  810.0  891.0  898.7
RE GRIDCART CART2 ELEV 16  819.0  832.2  857.7  823.0  823.3  826.0  862.0
RE GRIDCART CART2 ELEV 16  855.7  853.3  860.0  839.7  862.3  872.0  870.3
RE GRIDCART CART2 ELEV 17  899.6  822.7  827.8  937.3  881.7  871.8  915.9
RE GRIDCART CART2 ELEV 17  838.3  834.3  845.1  825.0  836.3  832.8  852.3
RE GRIDCART CART2 ELEV 17  860.4  862.2  871.7  878.1  885.4  862.0  874.2
RE GRIDCART CART2 ELEV 18  898.7  866.3  902.3  915.3  874.0  905.8  938.0
RE GRIDCART CART2 ELEV 18  857.3  853.5  852.2  846.7  879.7  836.8  854.0
RE GRIDCART CART2 ELEV 18  856.3  874.6  885.7  869.6  884.9  899.0  892.3
RE GRIDCART CART2 ELEV 19  909.0  852.0  926.3  940.0  874.0  867.0  919.0
RE GRIDCART CART2 ELEV 19  864.0  857.4  858.7  843.0  887.7  881.7  862.0
RE GRIDCART CART2 ELEV 19  865.0  864.7  906.0  866.7  905.3  927.0  902.0
RE GRIDCART CART2 ELEV 20  926.9  905.0  921.5  937.7  865.7  901.2  898.9
RE GRIDCART CART2 ELEV 20  881.7  857.8  868.6  885.0  853.5  889.7  871.3
RE GRIDCART CART2 ELEV 20  909.5  882.9  903.3  904.1  908.2  937.3  941.0
RE GRIDCART CART2 ELEV 21  942.0  935.7  881.7  919.2  895.0  908.7  896.5
RE GRIDCART CART2 ELEV 21  895.7  869.8  869.0  898.0  887.3  885.2  917.0
RE GRIDCART CART2 ELEV 21  903.3  881.2  908.0  967.8  936.2  906.0  958.7
RE GRIDCART CART2 END
RE DISCCART  705006.0  3649827.0  748.69
RE DISCCART  705031.0  3649872.0  753.28
RE DISCCART  705055.0  3649915.0  757.87
RE DISCCART  705080.0  3649960.0  761.15
RE DISCCART  705096.0  3650006.0  761.81
RE DISCCART  705116.0  3650031.0  761.81
RE DISCCART  705123.0  3650081.0  763.78
RE DISCCART  705137.0  3650129.0  762.14
RE DISCCART  705152.0  3650178.0  771.0
RE DISCCART  705166.0  3650226.0  763.78
RE DISCCART  705192.0  3650281.0  766.08
RE DISCCART  705214.0  3650326.0  768.7
RE DISCCART  705235.0  3650358.0  776.57
RE DISCCART  705276.0  3650407.0  783.46
RE DISCCART  705324.0  3650427.0  785.43
RE DISCCART  705371.0  3650450.0  787.07
RE DISCCART  705436.0  3650479.0  795.93
RE DISCCART  705471.0  3650519.0  796.92
RE DISCCART  705511.0  3650564.0  796.92
RE DISCCART  705516.0  3650614.0  792.32
RE DISCCART  705511.0  3650665.0  787.73
RE DISCCART  705505.0  3650698.0  783.79
RE DISCCART  705488.0  3650739.0  779.2
RE DISCCART  705473.0  3650788.0  776.57
RE DISCCART  705472.0  3650844.0  770.67
RE DISCCART  705483.0  3650898.0  771.98
RE DISCCART  705494.0  3650948.0  777.23
RE DISCCART  705505.0  3650998.0  778.54
RE DISCCART  705518.0  3651047.0  779.53
RE DISCCART  705530.0  3651095.0  785.43
RE DISCCART  705542.0  3651145.0  786.42
RE DISCCART  705554.0  3651191.0  782.15
RE DISCCART  705569.0  3651251.0  783.14
RE DISCCART  705586.0  3651309.0  786.75
RE DISCCART  705595.0  3651402.0  797.9
RE DISCCART  705602.0  3651434.0  798.88
RE DISCCART  705625.0  3651479.0  799.54
RE DISCCART  705653.0  3651519.0  816.6
RE DISCCART  705682.0  3651561.0  812.66
RE DISCCART  705706.0  3651599.0  812.34
RE DISCCART  705735.0  3651666.0  815.62
RE DISCCART  705739.0  3651716.0  817.59
```



```
RE DISCCART  705742.0  3651765.0  817.91
RE DISCCART  705745.0  3651816.0  818.57
RE DISCCART  705748.0  3651867.0  818.9
RE DISCCART  705752.0  3651918.0  822.83
RE DISCCART  705755.0  3651966.0  832.35
RE DISCCART  705758.0  3652015.0  841.21
RE DISCCART  705807.0  3652015.0  828.41
RE DISCCART  705857.0  3652015.0  822.18
RE DISCCART  705907.0  3652015.0  833.33
RE DISCCART  705957.0  3652015.0  842.19
RE DISCCART  706007.0  3652016.0  834.97
RE DISCCART  706059.0  3652016.0  831.69
RE DISCCART  706107.0  3652016.0  836.94
RE DISCCART  706157.0  3652016.0  858.27
RE DISCCART  706207.0  3652017.0  856.63
RE DISCCART  706247.0  3652017.0  846.13
RE DISCCART  706282.0  3651984.0  831.69
RE DISCCART  706322.0  3651951.0  824.48
RE DISCCART  706357.0  3651916.0  823.49
RE DISCCART  706394.0  3651882.0  822.51
RE DISCCART  706430.0  3651849.0  820.54
RE DISCCART  706467.0  3651815.0  819.23
RE DISCCART  706504.0  3651781.0  823.49
RE DISCCART  706542.0  3651746.0  832.02
RE DISCCART  706580.0  3651710.0  850.07
RE DISCCART  706617.0  3651677.0  834.65
RE DISCCART  706668.0  3651663.0  840.55
RE DISCCART  706716.0  3651652.0  840.22
RE DISCCART  706765.0  3651639.0  828.08
RE DISCCART  706814.0  3651627.0  822.51
RE DISCCART  706863.0  3651614.0  815.62
RE DISCCART  706912.0  3651603.0  814.3
RE DISCCART  706961.0  3651590.0  819.55
RE DISCCART  707010.0  3651578.0  823.16
RE DISCCART  707057.0  3651567.0  820.54
RE DISCCART  707106.0  3651554.0  819.55
RE DISCCART  707155.0  3651542.0  830.05
RE DISCCART  707203.0  3651529.0  848.1
RE DISCCART  707256.0  3651512.0  840.55
RE DISCCART  707299.0  3651539.0  831.04
RE DISCCART  707320.0  3651573.0  833.01
RE DISCCART  707370.0  3651574.0  833.01
RE DISCCART  707421.0  3651576.0  851.05
RE DISCCART  707471.0  3651578.0  853.67
RE DISCCART  707529.0  3651579.0  856.96
RE DISCCART  707562.1  3651552.0  850.72
RE DISCCART  707574.0  3651496.0  842.19
RE DISCCART  707609.0  3651459.0  839.57
RE DISCCART  707663.0  3651415.0  832.02
RE DISCCART  707712.0  3651400.0  829.72
RE DISCCART  707761.0  3651389.0  826.77
RE DISCCART  707810.0  3651377.0  823.16
RE DISCCART  707857.0  3651364.0  819.88
RE DISCCART  707906.0  3651353.0  815.29
RE DISCCART  707955.0  3651340.0  815.94
RE DISCCART  708005.0  3651329.0  819.23
RE DISCCART  708053.0  3651316.0  819.88
RE DISCCART  708104.0  3651304.0  823.16
RE DISCCART  708152.0  3651291.0  824.48
RE DISCCART  708187.0  3651283.0  825.46
RE DISCCART  708187.0  3651233.0  823.16
RE DISCCART  708186.0  3651183.0  821.52
RE DISCCART  708186.0  3651133.0  819.88
RE DISCCART  708186.0  3651083.0  817.91
RE DISCCART  708186.0  3651033.0  815.62
RE DISCCART  708186.0  3650983.0  814.3
RE DISCCART  708186.0  3650933.0  812.99
RE DISCCART  708186.0  3650883.0  812.34
RE DISCCART  708186.0  3650833.0  812.66
RE DISCCART  708186.0  3650783.0  809.38
RE DISCCART  708186.0  3650733.0  801.84
RE DISCCART  708186.0  3650683.0  797.9
RE DISCCART  708186.0  3650633.0  799.54
RE DISCCART  708186.0  3650583.0  802.17
RE DISCCART  708186.0  3650533.0  802.17
RE DISCCART  708186.0  3650483.0  801.51
RE DISCCART  708186.0  3650433.0  801.84
RE DISCCART  708186.0  3650383.0  799.21
RE DISCCART  708186.0  3650333.0  802.82
RE DISCCART  708186.0  3650283.0  805.12
RE DISCCART  708186.0  3650233.0  806.43
RE DISCCART  708186.0  3650183.0  804.79
RE DISCCART  708186.0  3650131.0  800.52
RE DISCCART  708135.0  3650102.0  790.68
RE DISCCART  708091.0  3650076.0  785.76
RE DISCCART  708046.0  3650050.0  791.01
RE DISCCART  708003.0  3650026.0  793.31
RE DISCCART  707960.0  3650001.0  792.98
RE DISCCART  707915.0  3649976.0  792.32
RE DISCCART  707872.0  3649950.0  791.67
RE DISCCART  707830.0  3649927.0  791.01
RE DISCCART  707787.0  3649902.0  789.37
RE DISCCART  707744.0  3649877.0  786.75
RE DISCCART  707701.0  3649852.0  783.79
RE DISCCART  707657.0  3649827.0  782.15
RE DISCCART  707613.0  3649802.0  782.15
```

```
RE DISCCART  707570.0  3649777.0  781.17
RE DISCCART  707525.0  3649752.0  779.86
RE DISCCART  707481.0  3649726.0  777.89
RE DISCCART  707425.0  3649695.0  769.03
RE DISCCART  707400.0  3649644.0  768.04
RE DISCCART  707372.0  3649585.0  765.09
RE DISCCART  707349.0  3649536.0  764.76
RE DISCCART  707327.0  3649490.0  774.93
RE DISCCART  707305.0  3649445.0  761.81
RE DISCCART  707282.0  3649398.0  763.12
RE DISCCART  707259.0  3649351.0  764.44
RE DISCCART  707235.0  3649303.0  774.93
RE DISCCART  707212.0  3649255.0  767.06
RE DISCCART  707173.0  3649227.0  753.94
RE DISCCART  707133.0  3649200.0  759.84
RE DISCCART  707094.0  3649171.0  761.15
RE DISCCART  707051.0  3649141.0  748.03
RE DISCCART  707001.0  3649141.0  758.53
RE DISCCART  706951.0  3649141.0  757.87
RE DISCCART  706901.0  3649141.0  755.58
RE DISCCART  706871.0  3649141.0  753.94
RE DISCCART  706861.0  3649093.0  750.98
RE DISCCART  706857.0  3649043.0  750.98
RE DISCCART  706851.0  3649000.0  750.98
RE DISCCART  706833.0  3648963.0  750.98
RE DISCCART  706792.0  3648936.0  750.33
RE DISCCART  706749.0  3648908.0  749.67
RE DISCCART  706706.0  3648881.0  745.41
RE DISCCART  706662.0  3648854.0  744.42
RE DISCCART  706617.0  3648825.0  744.75
RE DISCCART  706567.0  3648825.0  742.78
RE DISCCART  706517.0  3648825.0  742.45
RE DISCCART  706467.0  3648825.0  743.11
RE DISCCART  706417.0  3648825.0  742.45
RE DISCCART  706367.0  3648825.0  742.13
RE DISCCART  706321.0  3648825.0  743.11
RE DISCCART  706283.7  3648839.0  743.77
RE DISCCART  706258.0  3648852.0  743.11
RE DISCCART  706213.0  3648877.0  742.45
RE DISCCART  706169.0  3648901.0  742.13
RE DISCCART  706122.0  3648928.0  743.44
RE DISCCART  706075.0  3648957.0  743.77
RE DISCCART  706031.0  3648981.0  743.44
RE DISCCART  705984.0  3649007.0  743.77
RE DISCCART  705940.0  3649031.0  743.44
RE DISCCART  705892.1  3649055.0  740.16
RE DISCCART  705853.0  3649079.0  740.16
RE DISCCART  705809.0  3649105.0  740.81
RE DISCCART  705766.0  3649128.0  740.49
RE DISCCART  705723.0  3649154.0  740.16
RE DISCCART  705679.0  3649177.0  737.86
RE DISCCART  705636.0  3649202.0  736.22
RE DISCCART  705594.0  3649225.0  735.89
RE DISCCART  705558.0  3649245.0  736.22
RE DISCCART  705576.0  3649291.0  741.47
RE DISCCART  705596.0  3649338.0  742.13
RE DISCCART  705615.0  3649385.0  743.44
RE DISCCART  705634.0  3649432.0  746.06
RE DISCCART  705651.0  3649475.0  747.38
RE DISCCART  705609.0  3649499.0  746.06
RE DISCCART  705564.0  3649523.0  743.77
RE DISCCART  705519.0  3649547.0  743.44
RE DISCCART  705476.0  3649571.0  744.42
RE DISCCART  705431.0  3649596.0  743.77
RE DISCCART  705383.0  3649622.0  741.47
RE DISCCART  705341.0  3649645.0  741.14
RE DISCCART  705296.0  3649669.0  741.14
RE DISCCART  705253.0  3649693.0  740.81
RE DISCCART  705207.0  3649717.0  740.81
RE DISCCART  705161.0  3649741.0  739.5
RE DISCCART  705117.0  3649766.0  740.49
RE DISCCART  705076.0  3649789.0  746.06
RE DISCCART  705033.0  3649812.0  750.0
RE DISCCART  705586.0  3651364.0  798.88
RE FINISHED

ME STARTING
ME INPUTFIL  C:\TRINITY\YUMTUS89.ASC
ME ANEMHGHT  10.0  METERS
ME SURFDATA  3145  1989
ME UAIRDATA  23160  1989
ME STARTEND  89  01  01  1  89  12  31  24
ME FINISHED

OU STARTING
OU RECTABLE  24  FIRST
OU FINISHED


 *** Message Summary For ISCl Model Setup ***

 --------- Summary of Total Messages --------

A Total of          0 Fatal Error Message(s)
A Total of          1 Warning Message(s)
A Total of          0 Informational Message(s)
```



```
   ******** FATAL ERROR MESSAGES ********
              *** NONE  ***


   ********   WARNING MESSAGES   ********
SO W320    66 PPARM :Source Parameter May Be Out-of-Range for Parameter      QS

***********************************
*** SETUP Finishes Successfully ***
***********************************
```

0959xi36.doc

**MODELOPTs: CONC RURAL ELEV DFAULT

*** MODEL SETUP OPTIONS SUMMARY ***

**Intermediate Terrain Processing is Selected

**Model Is Setup For Calculation of Average CONCentration Values.

-- SCAVENGING/DEPOSITION LOGIC --
**Model Uses NO DRY DEPLETION. DDPLETE = F
**Model Uses NO WET DEPLETION. WDPLETE = F
**NO WET SCAVENGING Data Provided.
**Model Does NOT Use GRIDDED TERRAIN Data for Depletion Calculations

**Model Uses RURAL Dispersion.

**Model Uses Regulatory DEFAULT Options:
1. Final Plume Rise.
2. Stack-tip Downwash.
3. Buoyancy-induced Dispersion.
4. Use Calms Processing Routine.
5. Not Use Missing Data Processing Routine.
6. Default Wind Profile Exponents.
7. Default Vertical Potential Temperature Gradients.
8. "Upper Bound" Values for Supersquat Buildings.
9. No Exponential Decay for RURAL Mode

**Model Accepts Receptors on ELEV Terrain.

**Model Assumes No FLAGPOLE Receptor Heights.

**Model Calculates 1 Short Term Average(s) of: 24-HR

**This Run Includes: 43 Source(s); 1 Source Group(s); and 1014 Receptor(s)

**The Model Assumes A Pollutant Type of: PM10

**Model Set To Continue RUNning After the Setup Testing.

**Output Options Selected:
Model Outputs Tables of Highest Short Term Values by Receptor (RECTABLE Keyword)

**NOTE: The Following Flags May Appear Following CONC Values: c for Calm Hours
m for Missing Hours
b for Both Calm and Missing Hours

**Misc. Inputs: Anem. Hgt. (m) = 10.00 ; Decay Coef. = .0000 ; Rot. Angle = .0
Emission Units = GRAMS/SEC ; Emission Rate Unit Factor = .10000E+07
Output Units = MICROGRAMS/M**3

**Input Runstream File: C:\TRINITY\0959XI36.DAT ; **Output Print File: C:\TRINITY\0959XI36.LST
**File for Saving Result Arrays: SAVE1.FIL
**File for Initializing Result Arrays: C:\TRINITY\0959XI36.SV2

**Detailed Error/Message File: ERROR.LST

**MODELOPTs: CONC RURAL ELEV DFAULT

*** POINT SOURCE DATA ***

SOURCE ID	NUMBER PART. CATS.	EMISSION RATE (GRAMS/SEC)	X (METERS)	Y (METERS)	BASE ELEV. (METERS)	STACK HEIGHT (METERS)	STACK TEMP. (DEG.K)	STACK EXIT VEL. (M/SEC)	STACK DIAMETER (METERS)	BUILDING EXISTS	EMISSION RATE SCALAR VARY BY
ANSILOLD	0	.13125E-02	706591.0	3650227.0	243.8	22.16	299.81	8.17	.20	NO	
LIMELOAD	0	.35437E-03	706572.0	3650230.0	243.8	22.16	299.81	8.17	.20	NO	
JAWCRUSH	0	.38018E-03	705358.0	3649725.0	231.7	4.57	299.81	.01	1.83	NO	
PULVERIZ	0	.38018E-03	705344.0	3649697.0	231.7	1.52	299.81	.01	1.83	NO	
DIESGENR	0	.00000E+00	705549.0	3649588.0	231.7	3.05	322.04	21.34	.20	NO	

**MODELOPTs: CONC RURAL ELEV DFAULT

*** AREA SOURCE DATA ***

SOURCE ID	NUMBER PART. CATS.	EMISSION RATE (GRAMS/SEC /METER**2)	COORD (SW CORNER) X (METERS)	Y (METERS)	BASE ELEV. (METERS)	RELEASE HEIGHT (METERS)	X-DIM OF AREA (METERS)	Y-DIM OF AREA (METERS)	ORIENT. OF AREA (DEG.)	INIT. SZ (METERS)	EMISSION RATE SCALAR VARY BY
HEAPAREA	0	.84919E-06	706070.0	3649505.0	274.3	.00	700.00	273.98	30.00	4.56	
WASTESP1	0	.85100E-06	705324.0	3649918.0	289.6	.00	333.33	916.69	30.00	4.92	
WASTESP2	0	.85100E-06	705727.0	3649955.0	289.6	.00	160.42	641.68	30.00	4.92	
WASTESP3	0	.85100E-06	705969.0	3650067.0	289.6	.00	96.25	417.09	30.00	4.92	
WASTESP4	0	.85100E-06	706081.0	3650067.0	289.6	.00	48.12	304.80	30.00	4.92	
WASTESP5	0	.85100E-06	705936.0	3650003.0	289.6	.00	64.17	64.17	30.00	4.92	
HAULRD1	0	.10720E-04	706354.0	3650693.0	249.9	.00	30.48	192.51	-15.00	5.91	
HAULRD2	0	.10720E-04	706386.0	3650629.0	249.9	.00	30.48	48.12	-30.00	5.91	
HAULRD3	0	.10720E-04	706530.0	3650451.0	249.9	.00	30.48	224.59	-40.00	5.91	
HAULRD4	0	.84404E-05	706450.0	3650405.0	249.9	.00	30.48	80.21	31.00	5.86	
HAULRD5	0	.84404E-05	706317.0	3650260.0	259.1	.00	30.48	192.51	35.00	5.86	
HAULRD6	0	.84404E-05	706225.0	3650068.0	274.3	.00	30.48	208.55	30.00	5.86	
HAULRD7	0	.84404E-05	706065.0	3650020.0	281.9	.00	30.48	144.38	75.00	5.86	
HAULRD8	0	.84404E-05	705904.0	3649971.0	289.6	.00	30.48	144.38	72.00	5.86	
HAULRD9	0	.28342E-05	706556.0	3650468.0	243.8	.00	30.48	112.29	150.00	5.38	
HAULRD10	0	.29253E-05	706562.0	3650285.0	243.8	.00	30.48	96.25	20.00	5.31	
HAULRD11	0	.28342E-05	706482.0	3650116.0	243.8	.00	30.48	208.55	20.00	5.38	
HAULRD12	0	.28342E-05	706418.0	3649939.0	243.8	.00	30.48	176.46	20.00	5.38	
HAULRD13	0	.14682E-05	706386.0	3649923.0	243.8	.00	30.48	32.08	55.00	4.71	
HAULRD14	0	.28342E-05	706229.0	3649812.0	243.8	.00	30.48	192.51	55.00	5.38	
HAULRD15	0	.28342E-05	706128.0	3649658.0	243.8	.00	30.48	192.51	30.00	5.38	
DELIRD1	0	.64555E-06	705010.0	3649832.0	243.8	.00	9.14	91.40	30.00	2.52	
DELIRD2	0	.64555E-06	705083.0	3649923.0	243.8	.00	9.14	91.40	119.00	2.52	
DELIRD3	0	.64555E-06	705240.0	3649830.0	243.8	.00	9.14	91.40	119.00	2.52	
DELIRD4	0	.64555E-06	705407.0	3649734.0	243.8	.00	9.14	91.40	119.00	2.52	
DELIRD5	0	.64555E-06	705544.0	3649641.0	243.8	.00	9.14	91.40	50.00	2.52	
DELIRD6	0	.64555E-06	705690.0	3649761.0	243.8	.00	9.14	91.40	50.00	2.52	
DELIRD7	0	.64555E-06	705825.0	3649872.0	243.8	.00	9.14	91.40	88.00	2.52	
DELIRD8	0	.64555E-06	705987.0	3649879.0	243.8	.00	9.14	91.40	64.00	2.52	
DELIRD9	0	.64555E-06	706146.0	3649953.0	243.8	.00	9.14	91.40	64.00	2.52	
DELIRD10	0	.64555E-06	706303.0	3650027.0	243.8	.00	9.14	91.40	30.00	2.52	
DELIRD11	0	.64555E-06	706400.0	3650194.0	243.8	.00	9.14	91.40	30.00	2.52	
DELIRD12	0	.64555E-06	706464.0	3650308.0	243.8	.00	9.14	91.40	29.00	2.52	
DELIRD13	0	.64555E-06	706528.0	3650420.0	243.8	.00	9.14	64.17	110.00	2.52	
LIMEAPPL	0	.41282E-04	706555.0	3650237.0	243.8	.00	1.52	3.05	30.00	6.10	
LIMEHOPP	0	.40813E-02	706571.0	3650231.0	243.8	.00	.91	.91	30.00	6.10	
ANSILOUN	0	.93355E-03	706590.0	3650227.0	243.8	.00	.91	.91	.00	3.05	

**MODELOPTs: CONC RURAL ELEV DFAULT

*** OPENPIT SOURCE DATA ***

SOURCE ID	NUMBER PART. CATS.	EMISSION RATE (GRAMS/SEC /METER**2)	COORD (SW CORNER) X (METERS)	Y (METERS)	BASE ELEV. (METERS)	RELEASE HEIGHT (METERS)	X-DIM OF PIT (METERS)	Y-DIM OF PIT (METERS)	ORIENT. OF PIT (DEG.)	VOLUME OF PIT (M**3)	EMISSION RATE SCALAR VARY BY
WESTPIT	1	.17340E-05	705777.0	3651283.0	249.9	6.00	581.86	581.86	30.00	.62100E+08	

*** SOURCE IDs DEFINING SOURCE GROUPS ***

GROUP ID   SOURCE IDs

ALL   ANSILOLD, LIMELOAD, JAWCRUSH, PULVERIZ, DIESGENR, HEAPAREA, WASTESP1, WASTESP2, WASTESP3, WASTESP4, WASTESP5, HAULRD1 ,
        HAULRD2 , HAULRD3 , HAULRD4 , HAULRD5 , HAULRD6 , HAULRD7 , HAULRD8 , HAULRD9 , HAULRD10, HAULRD11, HAULRD12, HAULRD13,
        HAULRD14, HAULRD15, DELIRD1 , DELIRD2 , DELIRD3 , DELIRD4 , DELIRD5 , DELIRD6 , DELIRD7 , DELIRD8 , DELIRD9 , DELIRD10,
        DELIRD11, DELIRD12, DELIRD13, LIMEAPPL, LIMEHOPP, ANSILOUN, WESTPIT ,

*** SOURCE PARTICULATE/GAS DATA ***

*** SOURCE ID = WESTPIT ; SOURCE TYPE = OPENPIT ***

MASS FRACTION =
  1.00000,

PARTICLE DIAMETER (MICRONS) =
 10.00000,

PARTICLE DENSITY (G/CM**3) =
  2.50000,

**MODELOPTs: CONC RURAL ELEV DFAULT

*** GRIDDED RECEPTOR NETWORK SUMMARY ***

*** NETWORK ID: CART1 ; NETWORK TYPE: GRIDCART ***

*** X-COORDINATES OF GRID ***
(METERS)

699000.0, 700000.0, 701000.0, 702000.0, 703000.0, 704000.0, 705000.0, 706000.0, 707000.0, 708000.0,
709000.0, 710000.0, 711000.0, 712000.0, 713000.0, 714000.0, 715000.0, 716000.0, 717000.0,

*** Y-COORDINATES OF GRID ***
(METERS)

3642000.0, 3643000.0, 3644000.0, 3645000.0, 3646000.0, 3647000.0, 3648000.0, 3649000.0, 3650000.0, 3651000.0,
3652000.0, 3653000.0, 3654000.0, 3655000.0, 3656000.0, 3657000.0, 3658000.0, 3659000.0, 3660000.0,

**MODELOPTs: CONC RURAL ELEV DFAULT

*** NETWORK ID: CART1 ; NETWORK TYPE: GRIDCART ***

* ELEVATION HEIGHTS IN METERS *

Y-COORD (METERS)	X-COORD (METERS) 699000.00	700000.00	701000.00	702000.00	703000.00	704000.00	705000.00	706000.00	707000.00
3660000.00	360.88	350.00	447.96	567.54	465.22	380.48	346.25	333.85	290.78
3659000.00	343.51	321.90	327.05	409.65	603.50	502.25	392.19	328.03	400.05
3658000.00	272.28	284.68	314.95	410.78	452.38	537.09	518.77	430.71	363.75
3657000.00	261.52	276.67	275.33	282.55	325.13	446.14	425.81	474.97	359.57
3656000.00	249.11	260.18	261.52	282.55	311.23	313.70	323.79	321.87	339.79
3655000.00	237.74	241.40	254.14	266.09	280.51	296.72	287.52	304.46	286.60
3654000.00	234.70	238.14	243.75	250.24	263.56	263.13	301.75	286.82	282.34
3653000.00	220.46	225.06	230.61	239.36	268.35	287.12	272.80	265.12	269.81
3652000.00	215.80	223.54	244.82	237.23	254.87	274.20	268.74	254.29	253.84
3651000.00	210.62	223.81	228.60	233.78	240.88	261.12	262.13	250.45	250.55
3650000.00	206.75	215.98	221.62	216.01	233.17	233.72	239.18	234.03	236.68
3649000.00	192.73	204.70	204.34	212.66	214.09	222.20	222.29	226.77	230.18
3648000.00	196.29	196.38	199.13	203.61	207.17	211.74	214.88	222.44	223.02
3647000.00	180.44	190.20	193.85	194.07	199.64	204.28	214.49	220.07	222.93
3646000.00	177.70	183.98	190.99	202.08	206.56	215.01	224.64	229.64	238.05
3645000.00	175.56	180.44	188.58	202.69	222.20	230.95	231.04	244.08	269.05
3644000.00	168.95	174.65	186.17	200.47	226.34	251.37	249.11	261.82	289.59
3643000.00	164.90	168.31	180.99	193.33	214.55	303.22	300.44	400.96	374.14
3642000.00	163.07	161.54	170.90	186.84	212.84	297.88	306.93	447.60	474.97

*** NETWORK ID: CART1 ; NETWORK TYPE: GRIDCART ***

* ELEVATION HEIGHTS IN METERS *

Y-COORD (METERS)	X-COORD (METERS) 708000.00	709000.00	710000.00	711000.00	712000.00	713000.00	714000.00	715000.00	716000.00
3660000.00	268.53	221.07	189.13	59.44	47.76	40.93	34.75	26.52	19.90
3659000.00	354.57	298.16	237.29	89.40	53.71	44.81	36.88	35.57	27.61
3658000.00	387.61	352.68	289.86	93.97	63.49	60.38	40.45	31.09	38.19
3657000.00	372.47	302.36	395.84	78.03	72.45	50.20	51.51	38.10	48.07
3656000.00	321.78	260.36	234.91	67.88	64.74	65.26	54.77	57.45	32.13
3655000.00	314.34	318.03	324.58	107.20	87.57	76.72	64.01	50.29	51.45
3654000.00	288.95	297.88	316.02	110.95	104.55	91.53	60.66	49.07	59.74
3653000.00	276.76	292.21	285.66	87.78	77.27	60.59	66.35	60.81	54.16
3652000.00	265.69	266.46	273.25	80.68	72.60	70.71	61.66	66.14	71.60
3651000.00	247.50	253.81	262.52	75.29	69.10	78.85	72.24	67.57	67.27
3650000.00	241.71	243.05	248.05	78.03	81.44	87.72	78.55	74.74	76.05
3649000.00	233.78	239.82	239.73	79.95	83.58	79.00	83.91	85.89	86.90
3648000.00	230.12	235.31	245.88	77.42	77.82	77.33	77.42	78.64	81.59
3647000.00	232.35	235.43	237.99	74.98	74.41	72.30	75.50	75.22	77.85
3646000.00	251.76	249.69	248.84	72.63	68.95	68.58	71.32	72.30	78.15
3645000.00	274.32	260.91	259.48	73.15	71.23	67.06	66.75	69.59	74.98
3644000.00	254.29	264.23	266.27	84.22	71.99	66.51	63.31	65.96	68.76
3643000.00	286.60	281.09	298.76	103.85	84.89	65.78	61.26	64.01	65.53
3642000.00	303.58	262.74	250.24	88.70	80.47	68.28	64.01	58.83	61.87

*** NETWORK ID: CART1 ; NETWORK TYPE: GRIDCART ***

* ELEVATION HEIGHTS IN METERS *

Y-COORD (METERS)	X-COORD (METERS) 717000.00
3660000.00	17.98
3659000.00	18.90
3658000.00	28.44
3657000.00	42.37
3656000.00	51.91
3655000.00	46.63
3654000.00	46.63
3653000.00	58.73
3652000.00	86.87
3651000.00	74.07
3650000.00	85.65
3649000.00	92.26
3648000.00	84.12
3647000.00	80.68
3646000.00	78.33
3645000.00	78.33
3644000.00	68.58
3643000.00	64.31
3642000.00	62.18

**MODELOPTs: CONC RURAL ELEV DFAULT

*** GRIDDED RECEPTOR NETWORK SUMMARY ***

*** NETWORK ID: CART2 ; NETWORK TYPE: GRIDCART ***

*** X-COORDINATES OF GRID ***
(METERS)

704000.0, 704250.0, 704500.0, 704750.0, 705000.0, 705250.0, 705500.0, 705750.0, 706000.0, 706250.0,
706500.0, 706750.0, 707000.0, 707250.0, 707500.0, 707750.0, 708000.0, 708250.0, 708500.0, 708750.0,
709000.0,

*** Y-COORDINATES OF GRID ***
(METERS)

3648000.0, 3648250.0, 3648500.0, 3648750.0, 3649000.0, 3649250.0, 3649500.0, 3649750.0, 3650000.0, 3650250.0,
3650500.0, 3650750.0, 3651000.0, 3651250.0, 3651500.0, 3651750.0, 3652000.0, 3652250.0, 3652500.0, 3652750.0,
3653000.0,

**MODELOPTs: CONC RURAL ELEV DFAULT

*** NETWORK ID: CART2 ; NETWORK TYPE: GRIDCART ***

* ELEVATION HEIGHTS IN METERS *

Y-COORD (METERS)	X-COORD (METERS) 704000.00	704250.00	704500.00	704750.00	705000.00	705250.00	705500.00	705750.00	706000.00
3653000.00	287.12	285.20	268.74	280.17	272.80	276.97	273.25	273.01	265.12
3652750.00	282.52	275.84	280.87	285.81	263.87	274.69	273.98	268.74	261.46
3652500.00	277.06	259.69	282.34	286.51	266.40	264.26	280.11	263.35	261.34
3652250.00	273.92	264.05	275.02	278.98	266.40	276.09	285.90	261.31	260.15
3652000.00	274.20	250.76	252.31	285.69	268.74	265.72	279.17	255.51	254.29
3651750.00	271.06	253.59	276.76	264.17	246.89	271.58	273.92	249.63	253.65
3651500.00	263.23	252.77	269.14	243.54	273.80	261.34	259.66	249.84	251.09
3651250.00	263.99	251.06	261.03	240.76	266.18	246.37	239.63	245.97	251.86
3651000.00	261.12	238.35	238.75	262.22	262.13	239.88	237.23	245.67	250.45
3650750.00	259.99	242.01	239.27	242.01	235.31	237.93	237.38	245.46	243.05
3650500.00	254.69	233.48	236.59	235.37	236.43	238.66	243.66	241.49	239.42
3650250.00	249.02	227.69	227.78	231.13	237.44	233.78	235.40	237.13	236.83
3650000.00	233.72	224.42	227.26	230.64	239.18	232.35	231.04	233.69	234.03
3649750.00	225.37	225.64	227.44	234.79	226.07	226.53	228.36	231.13	234.06
3649500.00	224.85	224.94	225.95	231.43	224.94	225.34	226.77	229.51	230.12
3649250.00	224.24	222.72	221.71	223.17	223.42	223.36	224.58	226.37	228.11
3649000.00	222.20	222.72	218.72	220.80	222.29	222.14	223.48	224.94	226.77
3648750.00	218.24	219.76	214.98	219.46	223.42	219.55	220.98	222.20	224.64
3648500.00	215.98	217.93	217.11	216.62	216.80	222.29	220.22	222.60	222.20
3648250.00	213.42	215.28	214.06	216.59	216.41	216.71	218.24	222.90	221.71
3648000.00	211.74	213.97	212.54	215.49	214.88	214.58	217.32	213.36	222.44

**MODELOPTs: CONC RURAL ELEV DFAULT

*** NETWORK ID: CART2 ; NETWORK TYPE: GRIDCART ***

* ELEVATION HEIGHTS IN METERS *

Y-COORD (METERS)	X-COORD (METERS)								
	706250.00	706500.00	706750.00	707000.00	707250.00	707500.00	707750.00	708000.00	708250.00
3653000.00	264.87	273.71	270.45	269.81	279.50	275.33	268.59	276.76	294.99
3652750.00	264.75	269.75	260.15	271.18	265.57	277.22	269.11	275.33	275.57
3652500.00	261.73	256.95	270.57	268.74	262.74	263.65	263.56	276.15	264.17
3652250.00	259.75	258.07	268.13	255.06	260.30	261.00	266.58	269.96	265.05
3652000.00	257.59	251.46	254.90	253.84	259.78	262.25	262.80	265.69	267.64
3651750.00	261.43	250.85	250.94	251.76	262.74	260.82	260.09	262.13	255.94
3651500.00	258.38	248.81	247.50	251.09	256.73	257.89	253.78	250.94	252.07
3651250.00	253.04	244.75	247.38	250.97	252.47	251.16	248.29	249.42	250.91
3651000.00	250.24	245.06	240.18	250.55	243.84	246.89	246.80	247.50	247.89
3650750.00	242.13	238.66	242.53	247.71	241.40	248.05	248.93	247.59	243.96
3650500.00	238.38	237.96	238.90	238.81	238.26	242.56	241.07	241.80	242.86
3650250.00	237.35	237.44	238.66	238.75	238.96	241.19	241.61	242.01	241.92
3650000.00	235.31	235.31	236.71	236.68	237.74	240.18	240.97	241.71	240.44
3649750.00	235.88	236.22	235.03	233.08	234.39	237.56	239.39	241.01	239.30
3649500.00	233.48	226.16	230.64	231.43	235.61	233.78	235.52	236.83	239.88
3649250.00	228.84	228.81	230.31	231.59	235.70	233.23	234.76	236.01	238.17
3649000.00	227.50	227.38	228.97	230.18	227.08	231.53	232.81	233.78	235.31
3648750.00	225.64	225.55	227.69	228.90	229.51	232.26	231.95	233.48	234.18
3648500.00	222.99	223.11	225.43	226.83	225.86	229.97	231.77	233.26	232.50
3648250.00	222.32	222.29	224.45	225.61	223.81	227.81	229.03	230.34	229.39
3648000.00	223.63	218.24	221.59	223.02	223.42	226.07	227.78	230.12	233.17

**MODELOPTs: CONC RURAL ELEV DFAULT

*** NETWORK ID: CART2 ; NETWORK TYPE: GRIDCART ***

* ELEVATION HEIGHTS IN METERS *

Y-COORD (METERS)	X-COORD (METERS)		
	708500.00	708750.00	709000.00
3653000.00	285.35	276.15	292.21
3652750.00	276.82	285.69	286.82
3652500.00	275.94	282.55	274.93
3652250.00	269.72	274.02	271.97
3652000.00	269.87	262.74	266.46
3651750.00	262.83	265.79	265.27
3651500.00	261.21	260.91	257.98
3651250.00	255.06	252.68	252.56
3651000.00	251.76	252.68	253.81
3650750.00	248.23	249.72	251.64
3650500.00	247.68	248.72	250.24
3650250.00	245.97	245.97	246.58
3650000.00	245.67	245.88	243.05
3649750.00	243.08	241.71	248.59
3649500.00	241.10	242.32	244.75
3649250.00	239.45	240.70	242.44
3649000.00	237.13	238.05	239.82
3648750.00	236.52	237.44	239.27
3648500.00	233.96	235.09	236.95
3648250.00	232.87	234.70	237.13
3648000.00	234.09	233.17	235.31

**MODELOPTs: CONC RURAL ELEV DFAULT

*** DISCRETE CARTESIAN RECEPTORS ***
(X-COORD, Y-COORD, ZELEV, ZFLAG)
(METERS)

(705006.0,	3649827.0,	228.2,	.0);	(705031.0,	3649872.0,	229.6,	.0);
(705055.0,	3649915.0,	231.0,	.0);	(705080.0,	3649960.0,	232.0,	.0);
(705096.0,	3650006.0,	232.2,	.0);	(705116.0,	3650031.0,	232.2,	.0);
(705123.0,	3650081.0,	232.8,	.0);	(705137.0,	3650129.0,	232.3,	.0);
(705152.0,	3650178.0,	235.0,	.0);	(705166.0,	3650226.0,	232.8,	.0);
(705192.0,	3650281.0,	233.5,	.0);	(705214.0,	3650326.0,	234.3,	.0);
(705235.0,	3650358.0,	236.7,	.0);	(705276.0,	3650407.0,	238.8,	.0);
(705324.0,	3650427.0,	239.4,	.0);	(705371.0,	3650450.0,	239.9,	.0);
(705436.0,	3650479.0,	242.6,	.0);	(705471.0,	3650519.0,	242.9,	.0);
(705511.0,	3650564.0,	242.9,	.0);	(705516.0,	3650614.0,	241.5,	.0);
(705511.0,	3650665.0,	240.1,	.0);	(705505.0,	3650698.0,	238.9,	.0);
(705488.0,	3650739.0,	237.5,	.0);	(705473.0,	3650788.0,	236.7,	.0);
(705472.0,	3650844.0,	234.9,	.0);	(705483.0,	3650898.0,	235.3,	.0);
(705494.0,	3650948.0,	236.9,	.0);	(705505.0,	3650998.0,	237.3,	.0);
(705518.0,	3651047.0,	237.6,	.0);	(705530.0,	3651095.0,	239.4,	.0);
(705542.0,	3651145.0,	239.7,	.0);	(705554.0,	3651191.0,	238.4,	.0);
(705569.0,	3651251.0,	238.7,	.0);	(705586.0,	3651309.0,	239.8,	.0);
(705595.0,	3651402.0,	243.2,	.0);	(705602.0,	3651434.0,	243.5,	.0);
(705625.0,	3651479.0,	243.7,	.0);	(705653.0,	3651519.0,	248.9,	.0);
(705682.0,	3651561.0,	247.7,	.0);	(705706.0,	3651599.0,	247.6,	.0);
(705735.0,	3651666.0,	248.6,	.0);	(705739.0,	3651716.0,	249.2,	.0);
(705742.0,	3651765.0,	249.3,	.0);	(705745.0,	3651816.0,	249.5,	.0);
(705748.0,	3651867.0,	249.6,	.0);	(705752.0,	3651918.0,	250.8,	.0);
(705755.0,	3651966.0,	253.7,	.0);	(705758.0,	3652015.0,	256.4,	.0);
(705807.0,	3652015.0,	252.5,	.0);	(705857.0,	3652015.0,	250.6,	.0);
(705907.0,	3652015.0,	254.0,	.0);	(705957.0,	3652015.0,	256.7,	.0);
(706007.0,	3652016.0,	254.5,	.0);	(706059.0,	3652016.0,	253.5,	.0);
(706107.0,	3652016.0,	255.1,	.0);	(706157.0,	3652016.0,	261.6,	.0);
(706207.0,	3652017.0,	261.1,	.0);	(706247.0,	3652017.0,	257.9,	.0);
(706282.0,	3651984.0,	253.5,	.0);	(706322.0,	3651951.0,	251.3,	.0);
(706357.0,	3651916.0,	251.0,	.0);	(706394.0,	3651882.0,	250.7,	.0);
(706430.0,	3651849.0,	250.1,	.0);	(706467.0,	3651815.0,	249.7,	.0);
(706504.0,	3651781.0,	251.0,	.0);	(706542.0,	3651746.0,	253.6,	.0);
(706580.0,	3651710.0,	259.1,	.0);	(706617.0,	3651677.0,	254.4,	.0);
(706668.0,	3651663.0,	256.2,	.0);	(706716.0,	3651652.0,	256.1,	.0);
(706765.0,	3651639.0,	252.4,	.0);	(706814.0,	3651627.0,	250.7,	.0);
(706863.0,	3651614.0,	248.6,	.0);	(706912.0,	3651603.0,	248.2,	.0);
(706961.0,	3651590.0,	249.8,	.0);	(707010.0,	3651578.0,	250.9,	.0);
(707057.0,	3651567.0,	250.1,	.0);	(707106.0,	3651554.0,	249.8,	.0);
(707155.0,	3651542.0,	253.0,	.0);	(707203.0,	3651529.0,	258.5,	.0);
(707256.0,	3651512.0,	256.2,	.0);	(707299.0,	3651539.0,	253.3,	.0);
(707320.0,	3651573.0,	253.9,	.0);	(707370.0,	3651574.0,	253.9,	.0);
(707421.0,	3651576.0,	259.4,	.0);	(707471.0,	3651578.0,	260.2,	.0);
(707529.0,	3651579.0,	261.2,	.0);	(707562.1,	3651552.0,	259.3,	.0);
(707574.0,	3651496.0,	256.7,	.0);	(707609.0,	3651459.0,	255.9,	.0);

**MODELOPTs: CONC RURAL ELEV DFAULT

*** DISCRETE CARTESIAN RECEPTORS ***
(X-COORD, Y-COORD, ZELEV, ZFLAG)
(METERS)

(707663.0,	3651415.0,	253.6,	.0);	(707712.0,	3651400.0,	252.9,	.0);
(707761.0,	3651389.0,	252.0,	.0);	(707810.0,	3651377.0,	250.9,	.0);
(707857.0,	3651364.0,	249.9,	.0);	(707906.0,	3651353.0,	248.5,	.0);
(707955.0,	3651340.0,	248.7,	.0);	(708005.0,	3651329.0,	249.7,	.0);
(708053.0,	3651316.0,	249.9,	.0);	(708104.0,	3651304.0,	250.9,	.0);
(708152.0,	3651291.0,	251.3,	.0);	(708187.0,	3651283.0,	251.6,	.0);
(708187.0,	3651233.0,	250.9,	.0);	(708186.0,	3651183.0,	250.4,	.0);
(708186.0,	3651133.0,	249.9,	.0);	(708186.0,	3651083.0,	249.3,	.0);
(708186.0,	3651033.0,	248.6,	.0);	(708186.0,	3650983.0,	248.2,	.0);
(708186.0,	3650933.0,	247.8,	.0);	(708186.0,	3650883.0,	247.6,	.0);
(708186.0,	3650833.0,	247.7,	.0);	(708186.0,	3650783.0,	246.7,	.0);
(708186.0,	3650733.0,	244.4,	.0);	(708186.0,	3650683.0,	243.2,	.0);
(708186.0,	3650633.0,	243.7,	.0);	(708186.0,	3650583.0,	244.5,	.0);
(708186.0,	3650533.0,	244.5,	.0);	(708186.0,	3650483.0,	244.3,	.0);
(708186.0,	3650433.0,	244.4,	.0);	(708186.0,	3650383.0,	243.6,	.0);
(708186.0,	3650333.0,	244.7,	.0);	(708186.0,	3650283.0,	245.4,	.0);
(708186.0,	3650233.0,	245.8,	.0);	(708186.0,	3650183.0,	245.3,	.0);
(708186.0,	3650131.0,	244.0,	.0);	(708135.0,	3650102.0,	241.0,	.0);
(708091.0,	3650076.0,	239.5,	.0);	(708046.0,	3650050.0,	241.1,	.0);
(708003.0,	3650026.0,	241.8,	.0);	(707960.0,	3650001.0,	241.7,	.0);
(707915.0,	3649976.0,	241.5,	.0);	(707872.0,	3649950.0,	241.3,	.0);
(707830.0,	3649927.0,	241.1,	.0);	(707787.0,	3649902.0,	240.6,	.0);
(707744.0,	3649877.0,	239.8,	.0);	(707701.0,	3649852.0,	238.9,	.0);
(707657.0,	3649827.0,	238.4,	.0);	(707613.0,	3649802.0,	238.4,	.0);
(707570.0,	3649777.0,	238.1,	.0);	(707525.0,	3649752.0,	237.7,	.0);
(707481.0,	3649726.0,	237.1,	.0);	(707425.0,	3649695.0,	234.4,	.0);
(707400.0,	3649644.0,	234.1,	.0);	(707372.0,	3649585.0,	233.2,	.0);
(707349.0,	3649536.0,	233.1,	.0);	(707327.0,	3649490.0,	236.2,	.0);
(707305.0,	3649445.0,	232.2,	.0);	(707282.0,	3649398.0,	232.6,	.0);
(707259.0,	3649351.0,	233.0,	.0);	(707235.0,	3649303.0,	236.2,	.0);
(707212.0,	3649255.0,	233.8,	.0);	(707173.0,	3649227.0,	229.8,	.0);
(707133.0,	3649200.0,	231.6,	.0);	(707094.0,	3649171.0,	232.0,	.0);
(707051.0,	3649141.0,	228.0,	.0);	(707001.0,	3649141.0,	231.2,	.0);
(706951.0,	3649141.0,	231.0,	.0);	(706901.0,	3649141.0,	230.3,	.0);
(706871.0,	3649141.0,	229.8,	.0);	(706861.0,	3649093.0,	228.9,	.0);
(706857.0,	3649043.0,	228.9,	.0);	(706851.0,	3649000.0,	228.9,	.0);
(706833.0,	3648963.0,	228.9,	.0);	(706792.0,	3648936.0,	228.7,	.0);
(706749.0,	3648908.0,	228.5,	.0);	(706706.0,	3648881.0,	227.2,	.0);
(706662.0,	3648854.0,	226.9,	.0);	(706617.0,	3648825.0,	227.0,	.0);
(706567.0,	3648825.0,	226.4,	.0);	(706517.0,	3648825.0,	226.3,	.0);
(706467.0,	3648825.0,	226.5,	.0);	(706417.0,	3648825.0,	226.3,	.0);
(706367.0,	3648825.0,	226.2,	.0);	(706321.0,	3648825.0,	226.5,	.0);
(706283.7,	3648839.0,	226.7,	.0);	(706258.0,	3648852.0,	226.5,	.0);
(706213.0,	3648877.0,	226.3,	.0);	(706169.0,	3648901.0,	226.2,	.0);
(706122.0,	3648928.0,	226.6,	.0);	(706075.0,	3648957.0,	226.7,	.0);

**MODELOPTs: CONC RURAL ELEV DFAULT

*** DISCRETE CARTESIAN RECEPTORS ***
(X-COORD, Y-COORD, ZELEV, ZFLAG)
(METERS)

(	706031.0,	3648981.0,	226.6,	.0);	(705984.0,	3649007.0,	226.7,	.0);
(	705940.0,	3649031.0,	226.6,	.0);	(705892.1,	3649055.0,	225.6,	.0);
(	705851.0,	3649079.0,	225.6,	.0);	(705809.0,	3649105.0,	225.8,	.0);
(	705766.0,	3649128.0,	225.7,	.0);	(705723.0,	3649154.0,	225.6,	.0);
(	705679.0,	3649177.0,	224.9,	.0);	(705636.0,	3649202.0,	224.4,	.0);
(	705594.0,	3649225.0,	224.3,	.0);	(705558.0,	3649245.0,	224.4,	.0);
(	705576.0,	3649291.0,	226.0,	.0);	(705596.0,	3649338.0,	226.2,	.0);
(	705615.0,	3649385.0,	226.6,	.0);	(705634.0,	3649432.0,	227.4,	.0);
(	705651.0,	3649475.0,	227.8,	.0);	(705609.0,	3649499.0,	227.4,	.0);
(	705564.0,	3649523.0,	226.7,	.0);	(705519.0,	3649547.0,	226.6,	.0);
(	705476.0,	3649571.0,	226.9,	.0);	(705431.0,	3649596.0,	226.7,	.0);
(	705383.0,	3649622.0,	226.0,	.0);	(705341.0,	3649645.0,	225.9,	.0);
(	705296.0,	3649669.0,	225.9,	.0);	(705253.0,	3649693.0,	225.8,	.0);
(	705207.0,	3649717.0,	225.8,	.0);	(705161.0,	3649741.0,	225.4,	.0);
(	705117.0,	3649766.0,	225.7,	.0);	(705076.0,	3649789.0,	227.4,	.0);
(	705033.0,	3649812.0,	228.6,	.0);	(705586.0,	3651364.0,	243.5,	.0);

**MODELOPTs: CONC RURAL ELEV DFAULT

* SOURCE-RECEPTOR COMBINATIONS FOR WHICH CALCULATIONS MAY NOT BE PERFORMED *
LESS THAN 1.0 METER OR 3*ZLB IN DISTANCE, OR WITHIN OPEN PIT SOURCE

SOURCE ID	- - RECEPTOR LOCATION - - XR (METERS)	YR (METERS)	DISTANCE (METERS)
WESTPIT	706000.0	3651250.0	OPENPIT
WESTPIT	706250.0	3651250.0	OPENPIT
WESTPIT	706000.0	3651500.0	OPENPIT
WESTPIT	706250.0	3651500.0	OPENPIT
WESTPIT	706500.0	3651500.0	OPENPIT

**MODELOPTs: CONC RURAL ELEV DFAULT

*** METEOROLOGICAL DAYS SELECTED FOR PROCESSING ***
(1=YES; 0=NO)

1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

**MODELOPTs: CONC RURAL ELEV DFAULT

*** THE 1ST HIGHEST 24-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): ANSILOLD, LIMELOAD, JAWCRUSH, PULVERIZ, DIESGENR, HEAPAREA, WASTESP1, WASTESP2, WASTESP3, WASTESP4, WASTESP5, HAULRD1 , HAULRD2 , HAULRD3 , HAULRD4 , HAULRD5 , HAULRD6 , HAULRD7 , HAULRD8 , HAULRD9 , HAULRD10, HAULRD11, HAULRD12, HAULRD13, HAULRD14, HAULRD15, DELIRD1 , DELIRD2 , DELIRD3 , DELIRD4 , ...

*** NETWORK ID: CART1 ; NETWORK TYPE: GRIDCART ***

** CONC OF PM10 IN MICROGRAMS/M**3 **

Y-COORD (METERS)	X-COORD (METERS) 699000.00	700000.00	701000.00	702000.00	703000.00
3660000.0	.95564c(89093024)	1.14559c(89041624)	1.43758c(89082324)	1.68447c(89072324)	2.08088c(89042824)
3659000.0	1.18467c(89090324)	1.18286c(89041624)	1.36366c(89041624)	1.65458c(89043024)	2.06408c(89030124)
3658000.0	1.24780c(89090324)	1.22757c(89090324)	1.54779c(89041624)	1.83677c(89041624)	2.37194c(89042824)
3657000.0	1.07309c(89101124)	1.47800c(89090324)	1.32177c(89090324)	1.93368c(89041624)	2.15593 (89081224)
3656000.0	1.66242c(89101124)	1.15182c(89101124)	1.67105c(89090324)	1.57688c(89041624)	2.74868c(89041624)
3655000.0	1.37671c(89030824)	2.03910c(89101124)	1.29531c(89101124)	1.75958c(89090324)	2.39942c(89031024)
3654000.0	.99784c(89030924)	1.33937c(89030824)	2.33272c(89101124)	1.59139c(89101124)	1.93936c(89093024)
3653000.0	1.15034c(89090324)	1.44955c(89090324)	1.43686c(89030824)	2.36196c(89101124)	2.07360c(89101124)
3652000.0	2.44920 (89102024)	2.46876 (89102024)	2.42690 (89102024)	2.19363 (89102024)	2.65716c(89030824)
3651000.0	3.09279 (89102024)	3.12762 (89102024)	3.04885 (89102024)	2.85393 (89102024)	3.89506c(89102224)
3650000.0	2.01986 (89102024)	2.25691 (89102024)	2.54248 (89102024)	3.02888 (89102024)	4.47012c(89102224)
3649000.0	2.27073c(89102224)	1.97037c(89102224)	1.86108c(89110724)	2.35647c(89110724)	4.71944c(89050424)
3648000.0	1.28176c(89110724)	1.87025c(89050424)	2.14958c(89050424)	2.98472c(89111724)	5.83341c(89032224)
3647000.0	1.56429c(89101624)	1.66997c(89111124)	2.70351c(89111724)	3.64550c(89032224)	4.30924c(89022524)
3646000.0	1.98449c(89111724)	2.74052c(89032224)	2.56079 (89110124)	3.12002c(89022524)	3.52465c(89013124)
3645000.0	2.37015c(89032224)	2.23189 (89110124)	2.44598c(89022524)	3.12034c(89013124)	3.57446c(89012124)
3644000.0	1.95118 (89110124)	2.05791c(89022524)	2.66175c(89013124)	2.57298c(89012124)	2.42366c(89101224)
3643000.0	1.79360c(89022524)	2.20175c(89013124)	1.98042c(89011424)	2.73726c(89012124)	1.76243c(89022324)
3642000.0	1.81843c(89013124)	1.92485c(89013124)	2.27800c(89012124)	1.99588c(89101224)	1.64749c(89022324)

**MODELOPTs: CONC RURAL ELEV DFAULT

*** THE 1ST HIGHEST 24-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): ANSILOLD, LIMELOAD, JAWCRUSH, PULVERIZ, DIESGENR, HEAPAREA, WASTESP1, WASTESP2, WASTESP3, WASTESP4, WASTESP5, HAULRD1 , HAULRD2 , HAULRD3 , HAULRD4 , HAULRD5 , HAULRD6 , HAULRD7 , HAULRD8 , HAULRD9 , HAULRD10, HAULRD11, HAULRD12, HAULRD13, HAULRD14, HAULRD15, DELIRD1 , DELIRD2 , DELIRD3 , DELIRD4 , ...

*** NETWORK ID: CART1 ; NETWORK TYPE: GRIDCART ***

** CONC OF PM10 IN MICROGRAMS/M**3 **

Y-COORD (METERS)	X-COORD (METERS) 704000.00	705000.00	706000.00	707000.00	708000.00
3660000.0	1.97436c(89050824)	2.40386c(89050324)	2.88957c(89042724)	1.91609c(89050224)	2.04510 (89102424)
3659000.0	2.05875c(89112424)	2.99149c(89050324)	3.08394c(89042724)	2.15197c(89050224)	2.67581 (89102424)
3658000.0	2.45778c(89040924)	3.16475 (89080124)	3.29298c(89101524)	2.39138c(89050224)	2.83626 (89102424)
3657000.0	2.79725c(89051924)	3.09315 (89080124)	3.60335c(89101524)	2.59848c(89050224)	2.42848 (89102424)
3656000.0	3.48794c(89042824)	3.50172c(89050824)	3.92363c(89101524)	3.15610 (89102424)	2.16486 (89041724)
3655000.0	3.57488 (89081224)	4.10225c(89051924)	4.21756c(89101524)	4.82750 (89102424)	2.78274c(89021424)
3654000.0	3.81287c(89041624)	4.81609c(89051924)	5.37711c(89042724)	4.85038 (89102424)	2.80206c(89092824)
3653000.0	3.68649c(89041624)	6.06943c(89030124)	9.94047c(89042724)	5.45395 (89102424)	3.38177c(89022724)
3652000.0	3.76593c(89090324)	6.21404c(89041624)	16.00522c(89040924)	7.66286 (89041724)	5.29174c(89041424)
3651000.0	4.62767c(89102224)	8.69598c(89090324)	16.73123c(89101324)	11.59431c(89041424)	5.88902c(89071824)
3650000.0	7.39137c(89102224)	15.28308c(89102224)	61.25009c(89092424)	16.32725c(89062524)	5.07169c(89092024)
3649000.0	7.35925c(89111724)	12.94408c(89012124)	12.97248c(89012824)	13.52427c(89091924)	5.13760c(89091924)
3648000.0	6.48950c(89022524)	8.59026c(89012124)	7.16543 (89011524)	5.86510c(89050724)	4.41971c(89091924)
3647000.0	5.36505c(89012124)	4.23781c(89010224)	4.58354 (89011524)	4.47002 (89121624)	3.35256c(89111524)
3646000.0	3.88631c(89012124)	3.51850c(89010224)	3.66963c(89011924)	3.74806c(89100524)	2.49138c(89110924)
3645000.0	2.70442c(89022324)	2.47753c(89010224)	3.14165c(89011924)	3.55406c(89100524)	1.99021 (89011524)
3644000.0	2.23284c(89012824)	1.97917 (89121724)	2.67327c(89011924)	3.05818c(89100524)	1.92480c(89050724)
3643000.0	2.03758c(89010224)	2.02765 (89121724)	2.27076c(89011924)	2.53887c(89100524)	2.58840c(89050724)
3642000.0	1.87175c(89010224)	1.88626 (89121724)	1.93598c(89011924)	2.08098c(89100524)	2.19394c(89050724)

**MODELOPTs: CONC RURAL ELEV DFAULT

*** THE 1ST HIGHEST 24-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): ANSILOLD, LIMELOAD, JAWCRUSH, PULVERIZ, DIESGENR, HEAPAREA, WASTESP1, WASTESP2, WASTESP3, WASTESP4, WASTESP5, HAULRD1 , HAULRD2 , HAULRD3 , HAULRD4 , HAULRD5 , HAULRD6 , HAULRD7 , HAULRD8 , HAULRD9 , HAULRD10, HAULRD11, HAULRD12, HAULRD13, HAULRD14, HAULRD15, DELIRD1 , DELIRD2 , DELIRD3 , DELIRD4 , ...

*** NETWORK ID: CART1 ; NETWORK TYPE: GRIDCART ***

** CONC OF PM10 IN MICROGRAMS/M**3 **

Y-COORD (METERS)	X-COORD (METERS) 709000.00	710000.00	711000.00	712000.00	713000.00
3660000.0	1.70338c(89070324)	1.13346c(89021424)	1.16118c(89092824)	1.50874c(89070224)	.70271 (89081424)
3659000.0	1.55508 (89041724)	1.32525c(89021424)	1.57361c(89092824)	.90328c(89070224)	.84244c(89021424)
3658000.0	1.41596c(89021424)	1.51806c(89092824)	1.55914c(89070224)	.94986c(89021424)	1.09752c(89041424)
3657000.0	1.90941c(89021424)	1.87628c(89070224)	.98926c(89021424)	1.16544c(89041424)	1.07984c(89041424)
3656000.0	2.03985c(89092824)	1.44946c(89070224)	1.23568c(89041424)	1.43462c(89041424)	1.12950 (89061624)
3655000.0	2.15192c(89070224)	1.31784c(89041424)	1.87453c(89041424)	1.34069c(89092124)	1.49450c(89092424)
3654000.0	1.80807c(89022724)	2.05331c(89041424)	1.54729c(89092124)	1.94469c(89092424)	1.37053c(89071824)
3653000.0	2.64990c(89041424)	2.55159c(89092524)	1.78014c(89071824)	1.90820c(89071824)	1.49607c(89101224)
3652000.0	3.72719c(89071824)	2.26902c(89101224)	1.67456c(89031724)	1.51184c(89112624)	1.71561c(89112624)
3651000.0	3.73600c(89071824)	3.13241c(89022224)	2.05603c(89022224)	1.46476c(89022224)	1.28222c(89061724)
3650000.0	4.71834c(89092024)	3.67130c(89092024)	2.81090c(89092024)	2.17637c(89092024)	1.75540c(89092024)
3649000.0	3.38169c(89091924)	3.29963c(89100224)	2.46829c(89100224)	1.49952c(89100224)	1.33426c(89100224)
3648000.0	4.04903c(89091924)	2.99087c(89091924)	1.91474c(89062924)	1.95256c(89100224)	2.05644c(89100224)
3647000.0	2.85781c(89102524)	2.70663c(89030524)	2.42464c(89091924)	1.36281c(89091924)	1.33071c(89063024)
3646000.0	2.20213c(89022124)	2.00075c(89091924)	2.06980c(89091924)	1.89002c(89091924)	1.27443c(89091924)
3645000.0	1.95402c(89053024)	1.85094c(89111524)	1.48224c(89091924)	1.74273c(89091924)	1.84820c(89030524)
3644000.0	1.60695 (89011624)	1.89530c(89053024)	1.30151c(89111524)	1.14504c(89091924)	1.54267c(89091924)
3643000.0	1.62995c(89010624)	1.38723c(89053024)	1.44189c(89111524)	1.06434c(89102524)	.98046c(89021324)
3642000.0	1.29539c(89012524)	1.23751c(89111024)	1.52203c(89053024)	1.36796c(89111524)	.85823c(89102524)

**MODELOPTs: CONC RURAL ELEV DFAULT

*** THE 1ST HIGHEST 24-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): ANSILOLD, LIMELOAD, JAWCRUSH, PULVERIZ, DIESGENR, HEAPAREA, WASTESP1, WASTESP2, WASTESP3, WASTESP4, WASTESP5, HAULRD1 , HAULRD2 , HAULRD3 , HAULRD4 , HAULRD5 , HAULRD6 , HAULRD7 , HAULRD8 , HAULRD9 , HAULRD10, HAULRD11, HAULRD12, HAULRD13, HAULRD14, HAULRD15, DELIRD1 , DELIRD2 , DELIRD3 , DELIRD4 , ...

*** NETWORK ID: CART1 ; NETWORK TYPE: GRIDCART ***

** CONC OF PM10 IN MICROGRAMS/M**3 **

Y-COORD (METERS)	X-COORD (METERS) 714000.00	715000.00	716000.00	717000.00
3660000.0	.67759c(89021424)	.96950c(89041424)	.69853c(89092324)	.78636 (89061624)
3659000.0	1.03264c(89041424)	.75553c(89041424)	.86606 (89061624)	.61991c(89071724)
3658000.0	.87604c(89041424)	.95898 (89061624)	.69436c(89092124)	.95263c(89092424)
3657000.0	1.05936 (89061624)	1.00397c(89092124)	1.17207c(89092424)	.99772c(89092424)
3656000.0	1.21797c(89092124)	1.36861c(89092424)	.98027c(89111424)	.97865c(89071824)
3655000.0	1.41866c(89111424)	1.14013c(89071824)	.91365c(89111424)	.98278c(89101224)
3654000.0	1.21331c(89111424)	1.24020c(89101224)	.83031c(89101224)	.83365c(89031724)
3653000.0	1.11229c(89031724)	.89785c(89022224)	1.10601c(89022224)	1.13518c(89022224)
3652000.0	1.65115c(89022224)	1.49636c(89061724)	1.33043c(89061724)	1.11169c(89022224)
3651000.0	1.30548c(89061724)	1.27491c(89061724)	1.18720c(89061724)	1.09499c(89061724)
3650000.0	1.58825c(89092024)	1.60489c(89092024)	1.64805c(89092024)	1.61299c(89092024)
3649000.0	1.41615c(89092024)	1.51531c(89092024)	1.50252c(89092024)	1.39979c(89092024)
3648000.0	1.68400c(89100224)	1.15820c(89100224)	.99746c(89100224)	.91589c(89100224)
3647000.0	1.32070c(89063024)	1.44121c(89100224)	1.56074c(89100224)	1.35705c(89100224)
3646000.0	1.08330c(89100624)	.97107c(89063024)	1.09444c(89063024)	.99692c(89063024)
3645000.0	1.33873c(89030524)	.90231c(89091924)	.90181c(89100624)	.76093c(89100624)
3644000.0	1.45427c(89030524)	1.44029c(89030524)	.94572c(89030524)	.77140c(89100624)
3643000.0	1.36970c(89091924)	1.23126c(89091924)	1.44834c(89030524)	1.04418c(89030524)
3642000.0	.89044c(89021324)	1.20771c(89091924)	1.11869c(89091924)	1.26827c(89030524)

**MODELOPTs: CONC RURAL ELEV DFAULT

*** THE 1ST HIGHEST 24-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): ANSILOLD, LIMELOAD, JAWCRUSH, PULVERIZ, DIESGENR, HEAPAREA, WASTESP1,
WASTESP2, WASTESP3, WASTESP4, WASTESP5, HAULRD1 , HAULRD2 , HAULRD3 , HAULRD4 , HAULRD5 , HAULRD6 , HAULRD7 , HAULRD8 ,
HAULRD9 , HAULRD10, HAULRD11, HAULRD12, HAULRD13, HAULRD14, HAULRD15, DELIRD1 , DELIRD2 , DELIRD3 , DELIRD4 , ...

*** NETWORK ID: CART2 ; NETWORK TYPE: GRIDCART ***

** CONC OF PM10 IN MICROGRAMS/M**3 **

Y-COORD (METERS)	X-COORD (METERS) 704000.00	704250.00	704500.00	704750.00	705000.00
3653000.0	3.68649c(89041624)	3.81466c(89041624)	4.52266c(89070224)	4.90504c(89042824)	6.06943c(89030124)
3652750.0	3.30720c(89041624)	4.24285c(89041624)	4.39008c(89041624)	5.07587c(89042824)	5.89554c(89042824)
3652500.0	4.19434c(89090324)	4.03787c(89041624)	4.75509c(89041624)	5.07685c(89070224)	6.49574c(89042824)
3652250.0	4.54757c(89090324)	4.43296c(89090324)	4.79077c(89041624)	5.41833c(89041624)	5.85768c(89070224)
3652000.0	3.76593c(89090324)	5.51502c(89090324)	5.13729c(89090324)	5.54848c(89041624)	6.21404c(89041624)
3651750.0	3.66823c(89101124)	4.17466c(89090324)	5.74578c(89090324)	5.71470c(89090324)	6.78031c(89041624)
3651500.0	4.92061 (89102024)	5.57677 (89102024)	6.45754 (89102024)	7.66380 (89102024)	9.10025 (89102024)
3651250.0	3.95839c(89030824)	4.63875c(89101124)	4.86455c(89101124)	6.34438c(89090324)	7.51249c(89090324)
3651000.0	4.62767c(89102224)	4.58967c(89030824)	5.01956c(89090324)	5.81548c(89090324)	8.69598c(89090324)
3650750.0	3.80846 (89102024)	4.32130c(89090324)	4.92076c(89090324)	6.67475c(89090324)	7.90057c(89090324)
3650500.0	5.48521 (89102024)	5.61102 (89102024)	5.77982 (89102024)	6.96464c(89102224)	9.12741c(89102224)
3650250.0	6.19316 (89102024)	7.18698c(89102224)	8.87801c(89102224)	10.76592c(89102224)	13.22045c(89102224)
3650000.0	7.39137c(89102224)	9.14559c(89102224)	10.77732c(89102224)	12.12091c(89102224)	15.28308c(89102224)
3649750.0	8.57089c(89102224)	9.14292c(89102224)	8.77791c(89102224)	9.24723c(89110424)	15.55380c(89111724)
3649500.0	6.26000c(89110724)	6.68863c(89050424)	8.31383c(89111724)	12.64452c(89111724)	17.08472c(89111724)
3649250.0	6.12309c(89111724)	8.25544c(89111724)	11.08313c(89111724)	13.61123c(89111724)	16.71960c(89011424)
3649000.0	7.35925c(89111724)	9.12922c(89111724)	10.44338c(89032224)	12.26638c(89011424)	12.94408c(89012124)
3648750.0	7.70019c(89032224)	8.80870c(89032224)	9.12498c(89011424)	10.73135c(89012124)	11.13702c(89011424)
3648500.0	7.10895c(89032224)	7.14318c(89012824)	8.32520c(89022524)	9.64875c(89011424)	9.63115c(89012124)
3648250.0	6.52009c(89012824)	7.42066c(89022524)	8.44325c(89011424)	8.24791c(89012124)	9.10743c(89012124)
3648000.0	6.48950c(89022524)	7.50600c(89011424)	7.92281c(89012124)	7.08801c(89012124)	8.59026c(89012124)

**MODELOPTs: CONC RURAL ELEV DFAULT

*** THE 1ST HIGHEST 24-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): ANSILOLD, LIMELOAD, JAWCRUSH, PULVERIZ, DIESGENR, HEAPAREA, WASTESP1,
WASTESP2, WASTESP3, WASTESP4, WASTESP5, HAULRD1 , HAULRD2 , HAULRD3 , HAULRD4 , HAULRD5 , HAULRD6 , HAULRD7 , HAULRD8 ,
HAULRD9 , HAULRD10, HAULRD11, HAULRD12, HAULRD13, HAULRD14, HAULRD15, DELIRD1 , DELIRD2 , DELIRD3 , DELIRD4 , ...

*** NETWORK ID: CART2 ; NETWORK TYPE: GRIDCART ***

** CONC OF PM10 IN MICROGRAMS/M**3 **

Y-COORD (METERS)	X-COORD (METERS) 705250.00	705500.00	705750.00	706000.00	706250.00
3653000.0	6.15062c(89031524)	7.58479c(89030124)	8.01391c(89052924)	9.94047c(89042724)	8.99340c(89031224)
3652750.0	6.36483c(89031524)	7.17982c(89030124)	9.55388c(89040924)	11.69113c(89042724)	9.51671c(89050224)
3652500.0	6.98643c(89030124)	7.88073c(89031524)	10.32701c(89042824)	12.81744c(89042724)	10.83168c(89040224)
3652250.0	7.46596c(89042824)	8.02597c(89012724)	11.79169c(89030124)	13.40850c(89050824)	11.92041c(89031224)
3652000.0	7.60503c(89042824)	8.82423c(89051924)	11.01031c(89031524)	16.00522c(89040924)	13.84351c(89031224)
3651750.0	6.91062c(89070224)	9.37558c(89042824)	10.87585c(89012724)	18.93748c(89051924)	16.06323c(89031224)
3651500.0	9.91813 (89102024)	10.21488 (89102024)	11.16917 (89102024)	14.40690 (89072524)	14.18036c(89012724)
3651250.0	9.40699c(89091024)	10.95368c(89091024)	14.16420c(89110724)	18.14755c(89112524)	19.13949c(89051924)
3651000.0	9.95309c(89090324)	12.77459c(89041624)	17.77337c(89010524)	16.73123c(89101324)	39.44471c(89072324)
3650750.0	13.49386c(89090324)	15.64306c(89090324)	27.17848c(89031524)	21.56420c(89021424)	27.75855c(89101324)
3650500.0	12.13541c(89030824)	21.17496c(89090324)	36.91964c(89111224)	36.35865c(89012724)	27.10308 (89041724)
3650250.0	17.51547c(89102224)	30.65520c(89102224)	40.50839c(89111224)	38.95533c(89111224)	35.52841c(89012724)
3650000.0	22.78351c(89102224)	38.59201c(89111724)	40.53816c(89111724)	61.25009c(89092424)	44.72188c(89092024)
3649750.0	26.32636c(89111724)	36.84953c(89011424)	37.35917c(89011424)	31.04948c(89011424)	29.77514c(89031724)
3649500.0	22.72983c(89011424)	24.10079c(89012824)	22.83685c(89012124)	21.25859c(89012824)	30.50630 (89011524)
3649250.0	17.02653c(89012124)	18.42390c(89012124)	19.14436c(89012124)	19.31139c(89022324)	23.48133 (89011524)
3649000.0	13.66293c(89012124)	13.22085c(89012124)	12.99490c(89012124)	12.97248c(89012824)	16.50520 (89011524)
3648750.0	12.21165c(89012124)	13.39111c(89012124)	11.16252c(89012124)	10.81619 (89011524)	13.47149c(89011924)
3648500.0	10.88853c(89012124)	10.23842c(89012124)	8.90846c(89022324)	9.38204 (89011524)	11.20609c(89011924)
3648250.0	9.59639c(89012124)	8.16754c(89012124)	7.14858c(89012124)	8.12312 (89011524)	9.47875c(89011924)
3648000.0	8.20277c(89012124)	6.18592c(89012124)	5.81194c(89010224)	7.16543 (89011524)	8.33605c(89011924)

**MODELOPTs: CONC RURAL ELEV DFAULT

*** THE 1ST HIGHEST 24-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): ANSILOLD, LIMELOAD, JAWCRUSH, FULVERIZ, DIESGENR, HEAPAREA, WASTESP1,
WASTESP2, WASTESP3, WASTESP4, WASTESP5, HAULRD1 , HAULRD2 , HAULRD3 , HAULRD4 , HAULRD5 , HAULRD6 , HAULRD7 , HAULRD8 ,
HAULRD9 , HAULRD10, HAULRD11, HAULRD12, HAULRD13, HAULRD14, HAULRD15, DELIRD1 , DELIRD2 , DELIRD3 , DELIRD4 , . . . ,

*** NETWORK ID: CART2 ; NETWORK TYPE: GRIDCART ***

** CONC OF PM10 IN MICROGRAMS/M**3 **

Y-COORD (METERS)	X-COORD (METERS) 706500.00	706750.00	707000.00	707250.00	707500.00
3653000.0	7.08279c(89031224)	5.81717 (89102424)	5.45395 (89102424)	4.69057c(89092824)	3.95972c(89021424)
3652750.0	8.06431c(89031224)	6.12326 (89102424)	5.58767 (89102424)	4.58938c(89021424)	4.27679c(89021424)
3652500.0	9.01065c(89031224)	6.75792 (89102424)	5.82061c(89092824)	5.30149c(89021424)	4.79264c(89022724)
3652250.0	9.93066c(89031224)	7.65259 (89102424)	6.34299 (89041724)	5.07500c(89021424)	4.31572 (89041724)
3652000.0	10.97675c(89031224)	8.70635 (89102424)	7.66286 (89041724)	5.74927 (89021924)	4.78025c(89111424)
3651750.0	12.66583c(89031224)	9.53420 (89102424)	7.42011 (89021924)	6.00610 (89021924)	5.43291c(89041424)
3651500.0	12.49876c(89031224)	13.68252c(89112624)	9.55538 (89021924)	8.48442c(89041424)	8.75666c(89041424)
3651250.0	19.35389c(89031224)	11.73960c(89021424)	8.77404c(89022724)	9.25415c(89041424)	5.75051c(89071824)
3651000.0	21.27899c(89050224)	13.93091 (89021924)	11.59431c(89041424)	7.45417c(89071824)	7.24288c(89071824)
3650750.0	38.48837c(89050224)	18.57419c(89041424)	12.21395c(89071824)	10.36462c(89071824)	9.02605c(89071824)
3650500.0	68.15689c(89070224)	23.94209c(89071824)	16.75266c(89071824)	10.61034c(89112624)	8.01623c(89112624)
3650250.0	35.40572c(89092424)	25.84200c(89102524)	14.38379c(89100224)	9.53474c(89092024)	8.10616c(89092024)
3650000.0	30.50206c(89091924)	21.54866c(89100224)	16.32725c(89062524)	9.49307c(89100224)	7.94477c(89102524)
3649750.0	23.99085c(89091924)	17.46585c(89010624)	13.42012c(89102524)	11.35155c(89102524)	8.17971c(89102524)
3649500.0	27.55985c(89091924)	17.08914c(89112624)	11.40049c(89051024)	9.03467c(89091924)	8.55753c(89102524)
3649250.0	26.06041c(89022124)	27.64360c(89091924)	13.30798c(89091924)	9.81406c(89062524)	7.90771c(89091924)
3649000.0	17.24250 (89011524)	14.16282 (89011824)	13.52427c(89091924)	9.98067c(89091924)	8.44430c(89091924)
3648750.0	13.01272 (89011524)	10.37116 (89011524)	8.17778c(89111624)	8.66672c(89091924)	7.79245c(89091924)
3648500.0	10.25094c(89011924)	8.66922 (89011524)	6.61901c(89022124)	5.77824c(89022124)	6.56275c(89091924)
3648250.0	8.99308c(89011924)	7.27934 (89011524)	5.76365 (89011524)	5.51351c(89022124)	4.39591c(89102524)
3648000.0	8.12135c(89011924)	6.68950c(89100524)	5.86510c(89050724)	4.59627 (89011524)	4.95222c(89022124)

**MODELOPTs: CONC RURAL ELEV DFAULT

*** THE 1ST HIGHEST 24-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): ANSILOLD, LIMELOAD, JAWCRUSH, FULVERIZ, DIESGENR, HEAPAREA, WASTESP1,
WASTESP2, WASTESP3, WASTESP4, WASTESP5, HAULRD1 , HAULRD2 , HAULRD3 , HAULRD4 , HAULRD5 , HAULRD6 , HAULRD7 , HAULRD8 ,
HAULRD9 , HAULRD10, HAULRD11, HAULRD12, HAULRD13, HAULRD14, HAULRD15, DELIRD1 , DELIRD2 , DELIRD3 , DELIRD4 , . . . ,

*** NETWORK ID: CART2 ; NETWORK TYPE: GRIDCART ***

** CONC OF PM10 IN MICROGRAMS/M**3 **

Y-COORD (METERS)	X-COORD (METERS) 707750.00	708000.00	708250.00	708500.00	708750.00
3653000.0	3.99085c(89022724)	3.38177c(89022724)	2.67778c(89041424)	3.08912c(89041424)	2.71165c(89041424)
3652750.0	3.95932c(89022724)	2.88079c(89022724)	3.13826c(89041424)	2.81986c(89041424)	3.16782c(89041424)
3652500.0	3.62457 (89041724)	3.22438c(89041424)	3.17030c(89041424)	3.89842c(89041424)	3.01533c(89041424)
3652250.0	3.77021c(89111424)	3.85028c(89041424)	4.70556c(89041424)	3.37237c(89071724)	3.68289c(89071724)
3652000.0	4.64554c(89041424)	5.29174c(89041424)	4.19213c(89071724)	3.46978c(89071824)	3.92268c(89071824)
3651750.0	6.39576c(89041424)	4.41735c(89041424)	4.54927c(89041424)	4.01762c(89092424)	3.63234c(89111424)
3651500.0	5.14807c(89041424)	4.48603c(89041424)	4.46473c(89111424)	4.19713c(89071824)	4.18348c(89071824)
3651250.0	6.32178c(89092424)	6.50242c(89071824)	6.40424c(89071824)	5.32410c(89071824)	4.00187c(89071824)
3651000.0	6.89861c(89071824)	5.88902c(89071824)	4.72242c(89031324)	3.71106c(89071824)	3.73077c(89071824)
3650750.0	5.84331c(89071824)	5.37671c(89100224)	5.23549c(89022224)	5.07795c(89022224)	4.81061c(89022224)
3650500.0	6.85586c(89022224)	6.03787c(89022224)	4.95653c(89022224)	4.45713c(89061724)	3.91540c(89061724)
3650250.0	7.09993c(89092024)	6.30233c(89092024)	5.69366c(89092024)	5.19203c(89092024)	4.75075c(89092024)
3650000.0	6.61004c(89092024)	6.07169c(89092024)	5.67696c(89092024)	5.33054c(89092024)	5.01572c(89092024)
3649750.0	7.13964c(89100224)	6.59303c(89100224)	5.79555c(89100224)	4.84528c(89100224)	4.14061c(89100224)
3649500.0	7.02066c(89091924)	5.60414c(89102524)	4.98229c(89100224)	4.59542c(89100224)	4.26797c(89100224)
3649250.0	6.92147c(89091924)	6.39463c(89091924)	4.94714c(89102524)	4.47615c(89100224)	4.27997c(89100224)
3649000.0	7.22288c(89091924)	6.13760c(89091924)	5.77499c(89091924)	4.58328c(89091924)	4.01911c(89091924)
3648750.0	7.27493c(89091924)	6.24028c(89091924)	5.58060c(89091924)	5.26329c(89091924)	4.28464c(89091924)
3648500.0	6.19965c(89091924)	6.28941c(89091924)	5.52361c(89091924)	4.83232c(89091924)	4.77892c(89091924)
3648250.0	5.28323c(89091924)	5.38448c(89091924)	5.37586c(89091924)	4.93381c(89091924)	4.36379c(89091924)
3648000.0	3.68737c(89102524)	4.41971c(89091924)	4.84357c(89091924)	4.64868c(89091924)	4.32343c(89091924)

**MODELOPTs: CONC RURAL ELEV DFAULT

*** THE 1ST HIGHEST 24-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): ANSILOLD, LIMELOAD, JAWCRUSH, PULVERIZ, DIESGENR, HEAPAREA, WASTESP1, WASTESP2, WASTESP3, WASTESP4, WASTESP5, HAULRD1 , HAULRD2 , HAULRD3 , HAULRD4 , HAULRD5 , HAULRD6 , HAULRD7 , HAULRD8 , HAULRD9 , HAULRD10, HAULRD11, HAULRD12, HAULRD13, HAULRD14, HAULRD15, DELIRD1 , DELIRD2 , DELIRD3 , DELIRD4 , . . . ,

*** NETWORK ID: CART2 ; NETWORK TYPE: GRIDCART ***

** CONC OF PM10 IN MICROGRAMS/M**3 **

Y-COORD (METERS)	X-COORD (METERS) 709000.00
3653000.0	2.64990c(89041424)
3652750.0	2.64904c(89041424)
3652500.0	2.59101c(89041424)
3652250.0	3.05318c(89092424)
3652000.0	3.72719c(89071824)
3651750.0	3.12907c(89071824)
3651500.0	3.41831c(89071824)
3651250.0	3.53280c(89071824)
3651000.0	3.73600c(89071824)
3650750.0	4.31881c(89022224)
3650500.0	3.41829c(89061724)
3650250.0	4.34257c(89092024)
3650000.0	4.71834c(89092024)
3649750.0	3.59868c(89100224)
3649500.0	3.86446c(89100224)
3649250.0	4.02137c(89100224)
3649000.0	3.38169c(89091924)
3648750.0	3.89922c(89091924)
3648500.0	4.09278c(89091924)
3648250.0	4.18725c(89091924)
3648000.0	4.04903c(89091924)

**MODELOPTs: CONC RURAL ELEV DFAULT

*** THE 1ST HIGHEST 24-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): ANSILOLD, LIMELOAD, JAWCRUSH, PULVERIZ, DIESGENR, HEAPAREA, WASTESP1, WASTESP2, WASTESP3, WASTESP4, WASTESP5, HAULRD1 , HAULRD2 , HAULRD3 , HAULRD4 , HAULRD5 , HAULRD6 , HAULRD7 , HAULRD8 , HAULRD9 , HAULRD10, HAULRD11, HAULRD12, HAULRD13, HAULRD14, HAULRD15, DELIRD1 , DELIRD2 , DELIRD3 , DELIRD4 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF PM10 IN MICROGRAMS/M**3 **

X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)	X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)
705006.00	3649827.00	16.81946c	(89111724)	705031.00	3649872.00	20.39526c	(89102224)
705055.00	3649915.00	18.08590c	(89102224)	705080.00	3649960.00	16.96708c	(89102224)
705096.00	3650006.00	17.64514c	(89102224)	705116.00	3650031.00	18.15606c	(89102224)
705123.00	3650081.00	17.49018c	(89102224)	705137.00	3650129.00	16.67196c	(89102224)
705152.00	3650178.00	16.35520c	(89102224)	705166.00	3650226.00	16.18909c	(89102224)
705192.00	3650281.00	15.44289c	(89102224)	705214.00	3650326.00	14.63541c	(89102224)
705235.00	3650358.00	14.10904c	(89102224)	705276.00	3650407.00	14.41166c	(89111224)
705324.00	3650427.00	15.61786c	(89111224)	705371.00	3650450.00	16.84164c	(89111224)
705436.00	3650479.00	18.82420c	(89111224)	705471.00	3650519.00	19.88614c	(89090324)
705511.00	3650564.00	20.48505c	(89090324)	705516.00	3650614.00	19.19968c	(89090324)
705511.00	3650665.00	18.05218c	(89090324)	705505.00	3650698.00	17.26971c	(89090324)
705488.00	3650739.00	15.85807c	(89090324)	705473.00	3650788.00	14.32059c	(89090324)
705472.00	3650844.00	13.46138c	(89041624)	705483.00	3650898.00	13.47002c	(89041624)
705494.00	3650948.00	13.00537c	(89041624)	705505.00	3650998.00	12.91733c	(89031524)
705518.00	3651047.00	12.83569c	(89031524)	705530.00	3651095.00	12.83227	(89040824)
705542.00	3651145.00	12.46218c	(89102724)	705554.00	3651191.00	11.97185c	(89102724)
705569.00	3651251.00	11.39311c	(89030124)	705586.00	3651309.00	12.36119	(89102024)
705595.00	3651402.00	11.90058	(89102024)	705602.00	3651434.00	11.50889	(89102024)
705625.00	3651479.00	10.92828	(89102024)	705653.00	3651519.00	10.77016c	(89090324)
705682.00	3651561.00	9.74058c	(89051924)	705706.00	3651599.00	10.49015c	(89112524)
705735.00	3651666.00	11.21376c	(89112524)	705739.00	3651716.00	10.32111c	(89031524)
705742.00	3651765.00	10.76502c	(89012724)	705745.00	3651816.00	11.52374c	(89012724)
705748.00	3651867.00	11.72144c	(89012724)	705752.00	3651918.00	11.12828c	(89012724)
705755.00	3651966.00	10.89247c	(89031524)	705758.00	3652015.00	11.37834c	(89031524)
705807.00	3652015.00	12.50465c	(89031524)	705857.00	3652015.00	14.36942c	(89030124)
705907.00	3652015.00	14.59516c	(89042824)	705957.00	3652015.00	16.38309c	(89040924)
706007.00	3652016.00	14.89790c	(89040924)	706059.00	3652016.00	16.15767c	(89050824)
706107.00	3652016.00	18.08345c	(89042724)	706157.00	3652016.00	16.70927c	(89042724)
706207.00	3652017.00	14.19470c	(89031224)	706247.00	3652017.00	13.71842c	(89031224)
706282.00	3651984.00	13.73849c	(89031224)	706322.00	3651951.00	13.90072c	(89031224)
706357.00	3651916.00	13.77225c	(89031224)	706394.00	3651882.00	12.83225c	(89031224)
706430.00	3651849.00	12.39259c	(89031224)	706467.00	3651815.00	12.62611c	(89031224)
706504.00	3651781.00	12.13592c	(89031224)	706542.00	3651746.00	11.27281c	(89050224)
706580.00	3651710.00	11.18135c	(89050224)	706617.00	3651677.00	11.00787c	(89112624)
706668.00	3651663.00	10.65426c	(89112624)	706716.00	3651652.00	10.25803	(89102424)
706765.00	3651639.00	10.08859	(89041724)	706814.00	3651627.00	10.11546	(89041724)
706863.00	3651614.00	9.26812c	(89112624)	706912.00	3651603.00	8.92215c	(89112624)
706961.00	3651590.00	8.68722c	(89112624)	707010.00	3651578.00	8.41612c	(89112624)
707057.00	3651567.00	8.39187	(89021924)	707106.00	3651554.00	8.18083c	(89041424)
707155.00	3651542.00	8.14491c	(89041424)	707203.00	3651529.00	8.33519c	(89041424)

**MODELOPTs: CONC RURAL ELEV DFAULT

*** THE 1ST HIGHEST 24-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): ANSILOLD, LIMELOAD, JAWCRUSH, PULVERIZ, DIESGENR, HEAPAREA, WASTESP1, WASTESP2, WASTESP3, WASTESP4, WASTESP5, HAULRD1 , HAULRD2 , HAULRD3 , HAULRD4 , HAULRD5 , HAULRD6 , HAULRD7 , HAULRD8 , HAULRD9 , HAULRD10, HAULRD11, HAULRD12, HAULRD13, HAULRD14, HAULRD15, DELIRD1 , DELIRD2 , DELIRD3 , DELIRD4 , ...

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF PM10 IN MICROGRAMS/M**3 **

X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)	X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)
707256.00	3651512.00	8.49383c	(89041424)	707299.00	3651539.00	8.41307c	(89041424)
707320.00	3651573.00	8.10669c	(89041424)	707370.00	3651574.00	8.18687c	(89041424)
707421.00	3651576.00	8.24860c	(89041424)	707471.00	3651578.00	8.38443c	(89041424)
707529.00	3651579.00	8.66533c	(89041424)	707562.10	3651552.00	8.78965c	(89041424)
707574.00	3651496.00	7.74423c	(89041424)	707609.00	3651459.00	6.02662c	(89041424)
707663.00	3651415.00	4.89781c	(89041424)	707712.00	3651400.00	4.99856c	(89071824)
707761.00	3651389.00	5.09332c	(89071824)	707810.00	3651377.00	5.19492c	(89092424)
707857.00	3651364.00	5.49704c	(89092424)	707906.00	3651353.00	5.67256c	(89092424)
707955.00	3651340.00	5.62617c	(89092424)	708005.00	3651329.00	5.66430c	(89071824)
708053.00	3651316.00	5.92268c	(89071824)	708104.00	3651304.00	6.18195c	(89071824)
708152.00	3651291.00	6.36974c	(89071824)	708187.00	3651283.00	6.42941c	(89071824)
708187.00	3651233.00	6.51324c	(89071824)	708186.00	3651183.00	6.30683c	(89071824)
708186.00	3651133.00	5.92522c	(89071824)	708186.00	3651083.00	5.41275c	(89071824)
708186.00	3651033.00	4.91706c	(89031324)	708186.00	3650983.00	4.84420c	(89031324)
708186.00	3650933.00	4.53622c	(89031324)	708186.00	3650883.00	4.77205c	(89100224)
708186.00	3650833.00	4.93715c	(89100224)	708186.00	3650783.00	5.07592c	(89100224)
708186.00	3650733.00	5.36863c	(89022224)	708186.00	3650683.00	5.59276c	(89022224)
708186.00	3650633.00	5.74713c	(89022224)	708186.00	3650583.00	5.77097c	(89022224)
708186.00	3650533.00	5.53717c	(89022224)	708186.00	3650483.00	5.03781c	(89061724)
708186.00	3650433.00	4.96674c	(89061724)	708186.00	3650383.00	4.92848c	(89092024)
708186.00	3650333.00	5.38396c	(89092024)	708186.00	3650283.00	5.68547c	(89092024)
708186.00	3650233.00	6.26999c	(89092024)	708186.00	3650183.00	6.50744c	(89092024)
708186.00	3650131.00	6.65393c	(89092024)	708135.00	3650102.00	6.75539c	(89092024)
708091.00	3650076.00	6.74120c	(89092024)	708046.00	3650050.00	6.61733c	(89092024)
708003.00	3650026.00	6.41457c	(89092024)	707960.00	3650001.00	6.16045c	(89092024)
707915.00	3649976.00	5.88451c	(89092024)	707872.00	3649950.00	6.16314c	(89100224)
707830.00	3649927.00	6.55544c	(89100224)	707787.00	3649902.00	6.98221c	(89100224)
707744.00	3649877.00	7.35559c	(89100224)	707701.00	3649852.00	7.58589c	(89100224)
707657.00	3649827.00	7.68484c	(89100224)	707613.00	3649802.00	7.78361c	(89100224)
707570.00	3649777.00	7.88023c	(89100224)	707525.00	3649752.00	7.95589c	(89100224)
707481.00	3649726.00	8.49614c	(89102524)	707425.00	3649695.00	9.49385c	(89091924)
707400.00	3649644.00	9.76212c	(89102524)	707372.00	3649585.00	9.86175c	(89102524)
707349.00	3649536.00	9.17544c	(89102524)	707327.00	3649490.00	8.67467c	(89091924)
707305.00	3649445.00	8.70636c	(89091924)	707282.00	3649398.00	9.24322c	(89102524)
707259.00	3649351.00	9.27092c	(89062524)	707235.00	3649303.00	10.30292c	(89062524)
707212.00	3649255.00	10.23370c	(89100224)	707173.00	3649227.00	10.98367c	(89100224)
707133.00	3649200.00	10.76593c	(89091924)	707094.00	3649171.00	11.90390c	(89091924)
707051.00	3649141.00	13.41057c	(89091924)	707001.00	3649141.00	14.95419c	(89091924)
706951.00	3649141.00	16.51621c	(89091924)	706901.00	3649141.00	17.90396c	(89091924)
706871.00	3649141.00	18.61289c	(89091924)	706861.00	3649093.00	17.03636c	(89091924)

**MODELOPTs: CONC RURAL ELEV DFAULT

*** THE 1ST HIGHEST 24-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): ANSILOLD, LIMELOAD, JAWCRUSH, PULVERIZ, DIESGENR, HEAPAREA, WASTESP1, WASTESP2, WASTESP3, WASTESP4, WASTESP5, HAULRD1 , HAULRD2 , HAULRD3 , HAULRD4 , HAULRD5 , HAULRD6 , HAULRD7 , HAULRD8 , HAULRD9 , HAULRD10, HAULRD11, HAULRD12, HAULRD13, HAULRD14, HAULRD15, DELIRD1 , DELIRD2 , DELIRD3 , DELIRD4 , ...

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF PM10 IN MICROGRAMS/M**3 **

X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)	X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)
706857.00	3649043.00	14.53425c	(89111624)	706851.00	3649000.00	13.75170c	(89111624)
706833.00	3648963.00	12.79313c	(89111624)	706792.00	3648936.00	12.43073	(89011824)
706749.00	3648908.00	12.82732	(89011824)	706706.00	3648881.00	12.58461	(89011524)
706662.00	3648854.00	13.19860	(89011524)	706617.00	3648825.00	12.93835	(89011524)
706567.00	3648825.00	13.49284	(89011524)	706517.00	3648825.00	14.02683	(89011524)
706467.00	3648825.00	14.20321	(89011524)	706417.00	3648825.00	15.06417c	(89011924)
706367.00	3648825.00	15.02962c	(89011924)	706321.00	3648825.00	14.68156c	(89011924)
706283.70	3648839.00	14.61421c	(89011924)	706258.00	3648852.00	14.55680c	(89011924)
706213.00	3648877.00	14.16729	(89011524)	706169.00	3648901.00	14.31202	(89011524)
706122.00	3648928.00	14.54932	(89011524)	706075.00	3648957.00	13.98435	(89011524)
706031.00	3648981.00	12.84765	(89011524)	705984.00	3649007.00	13.54457c	(89012824)
705940.00	3649031.00	14.79823c	(89022324)	705892.10	3649055.00	14.83648c	(89022324)
705853.00	3649079.00	14.78732c	(89012124)	705809.00	3649105.00	14.20182c	(89011424)
705766.00	3649128.00	16.00043c	(89012124)	705723.00	3649154.00	19.20044c	(89012124)
705679.00	3649177.00	16.31061c	(89012124)	705636.00	3649202.00	14.62956c	(89012124)
705594.00	3649225.00	15.93024c	(89012124)	705558.00	3649245.00	18.62534c	(89012124)
705576.00	3649291.00	19.65615c	(89012124)	705596.00	3649338.00	20.47993c	(89012124)
705615.00	3649385.00	21.15497c	(89012124)	705634.00	3649432.00	21.81190c	(89012124)
705651.00	3649475.00	22.59215c	(89012124)	705609.00	3649499.00	22.52742c	(89012124)
705564.00	3649523.00	24.90517c	(89012824)	705519.00	3649547.00	25.06518c	(89012824)
705476.00	3649571.00	27.24440c	(89011424)	705431.00	3649596.00	29.59842c	(89011424)
705383.00	3649622.00	28.23583c	(89011424)	705341.00	3649645.00	27.38811c	(89011424)
705296.00	3649669.00	25.87886c	(89011424)	705253.00	3649693.00	24.75152c	(89111724)
705207.00	3649717.00	23.94119c	(89111724)	705161.00	3649741.00	21.83818c	(89111724)
705117.00	3649766.00	19.82292c	(89111724)	705076.00	3649789.00	17.83898c	(89111724)
705033.00	3649812.00	15.98762c	(89111724)	705586.00	3651364.00	12.38704	(89102024)

**MODELOPTs: CONC RURAL ELEV DFAULT

*** THE SUMMARY OF HIGHEST 24-HR RESULTS ***

** CONC OF PM10 IN MICROGRAMS/M**3 **

GROUP ID	AVERAGE CONC	DATE (YYMMDDHH)	RECEPTOR (XR, YR, ZELEV, ZFLAG)	OF TYPE	NETWORK GRID-ID
ALL	HIGH 1ST HIGH VALUE IS	68.15689c	ON 89070224: AT (706500.00, 3650500.00, 237.96, .00)	GC	CART2

*** RECEPTOR TYPES: GC = GRIDCART
GP = GRIDPOLR
DC = DISCCART
DP = DISCPOLR
BD = BOUNDARY

**MODELOPTs: CONC RURAL ELEV DFAULT

*** Message Summary : ISCST3 Model Execution ***

--------- Summary of Total Messages --------

A Total of 0 Fatal Error Message(s)
A Total of 1 Warning Message(s)
A Total of 875 Informational Message(s)

A Total of 875 Calm Hours Identified

******** FATAL ERROR MESSAGES ********
*** NONE ***

******** WARNING MESSAGES ********
SO W320 66 PPARM :Source Parameter May Be Out-of-Range for Parameter QS

****
*** ISCST3 Finishes UN-successfully ***
****

APPENDIX L-2

Maximum 24-Hour PM_{10} Concentrations
100 Meter Receptor Grid

```
1                    ISCST3 - (DATED 96113)

                IBM-PC VERSION (3.00)    ISCST3R
        (C) COPYRIGHT 1992-1996, TRINITY CONSULTANTS, INC.

 Run Began on  8/09/1996 at 13:13:18


 ** BREEZE AIR ISCST3 - C:\TRINITY\0959XI37.DAT
 ** Trinity Consultants Incorporated, Dallas, TX

 CO STARTING
 CO TITLEONE  IMPERIAL PROJECT PM-10 IMPACT ASSESSMENT
 CO TITLETWO  AVG. ANNUAL IMPACTS - 1000 M/250 M GRIDS & DISCRETE RECEPTORS
 CO MODELOPT  DFAULT  CONC  RURAL
 CO AVERTIME  PERIOD
 CO POLLUTID  PM10
 CO TERRHGTS  ELEV
 CO RUNORNOT  RUN
 CO SAVEFILE  SAVE1.FIL  5  C:\TRINITY\0959XI37.SV2
 CO ERRORFIL  ERROR.LST
 CO FINISHED

 SO STARTING
 SO ELEVUNIT  METERS
 SO LOCATION  ANSILOLD  POINT  706591.0  3650227.0  243.84
 SO LOCATION  LIMELOAD  POINT  706572.0  3650230.0  243.84
 SO LOCATION  JAWCRUSH  POINT  705358.0  3649725.0  231.65
 SO LOCATION  PULVERIZ  POINT  705344.0  3649697.0  231.65
 SO LOCATION  DIESGENR  POINT  705549.0  3649588.0  231.65
 SO LOCATION  HEAPAREA  AREA  706070.0  3649505.0  274.32
 SO LOCATION  WASTESP1  AREA  705324.0  3649918.0  289.56
 SO LOCATION  WASTESP2  AREA  705727.0  3649955.0  289.56
 SO LOCATION  WASTESP3  AREA  705969.0  3650067.0  289.56
 SO LOCATION  WASTESP4  AREA  706081.0  3650067.0  289.56
 SO LOCATION  WASTESP5  AREA  705936.0  3650003.0  289.56
 SO LOCATION  HAULRD1  AREA  706354.0  3650693.0  249.94
 SO LOCATION  HAULRD2  AREA  706386.0  3650629.0  249.94
 SO LOCATION  HAULRD3  AREA  706530.0  3650453.0  249.94
 SO LOCATION  HAULRD4  AREA  706450.0  3650405.0  249.94
 SO LOCATION  HAULRD5  AREA  706337.0  3650260.0  259.08
 SO LOCATION  HAULRD6  AREA  706225.0  3650068.0  274.32
 SO LOCATION  HAULRD7  AREA  706065.0  3650020.0  281.94
 SO LOCATION  HAULRD8  AREA  705904.0  3649971.0  289.56
 SO LOCATION  HAULRD9  AREA  706556.0  3650468.0  243.84
 SO LOCATION  HAULRD10  AREA  706562.0  3650285.0  243.84
 SO LOCATION  HAULRD11  AREA  706482.0  3650116.0  243.84
 SO LOCATION  HAULRD12  AREA  706418.0  3649939.0  243.84
 SO LOCATION  HAULRD13  AREA  706386.0  3649923.0  243.84
 SO LOCATION  HAULRD14  AREA  706229.0  3649812.0  243.84
 SO LOCATION  HAULRD15  AREA  706128.0  3649658.0  243.84
 SO LOCATION  DELIRD1  AREA  705010.0  3649832.0  243.84
 SO LOCATION  DELIRD2  AREA  705081.0  3649923.0  243.84
 SO LOCATION  DELIRD3  AREA  705240.0  3649830.0  243.84
 SO LOCATION  DELIRD4  AREA  705407.0  3649734.0  243.84
 SO LOCATION  DELIRD5  AREA  705544.0  3649641.0  243.84
 SO LOCATION  DELIRD6  AREA  705690.0  3649761.0  243.84
 SO LOCATION  DELIRD7  AREA  705825.0  3649872.0  243.84
 SO LOCATION  DELIRD8  AREA  705987.0  3649879.0  243.84
 SO LOCATION  DELIRD9  AREA  706146.0  3649953.0  243.84
 SO LOCATION  DELIRD10  AREA  706303.0  3650027.0  243.84
 SO LOCATION  DELIRD11  AREA  706400.0  3650194.0  243.84
 SO LOCATION  DELIRD12  AREA  706464.0  3650308.0  243.84
 SO LOCATION  DELIRD13  AREA  706528.0  3650420.0  243.84
 SO LOCATION  LIMEAPPL  AREA  706555.0  3650237.0  243.84
 SO LOCATION  LIMEHOPP  AREA  706571.0  3650231.0  243.84
 SO LOCATION  ANSILOUN  AREA  706590.0  3650227.0  243.84
 SO LOCATION  WESTPIT  OPENPIT  705777.0  3651283.0  249.94
 SO SRCPARAM  ANSILOLD  7.87500000E-04  22.16  299.81  8.17  0.20
 SO SRCPARAM  LIMELOAD  2.12625000E-04  22.16  299.81  8.17  0.20
 SO SRCPARAM  JAWCRUSH  3.80525000E-04  4.57  299.81  0.01  1.83
 SO SRCPARAM  PULVERIZ  3.80525000E-04  1.52  299.81  0.01  1.83
 SO SRCPARAM  DIESGENR  2.03112000E-04  3.05  322.04  21.34  0.20
 SO SRCPARAM  HEAPAREA  7.99552000E-07  0.00  700.00  273.98  30.0  4.56
 SO SRCPARAM  WASTESP1  7.92692000E-07  0.00  333.33  916.69  30.0  5.07
 SO SRCPARAM  WASTESP2  7.92692000E-07  0.00  160.42  641.68  30.0  5.07
 SO SRCPARAM  WASTESP3  7.92692000E-07  0.00  96.25  417.09  30.0  5.07
 SO SRCPARAM  WASTESP4  7.92692000E-07  0.00  48.12  304.80  30.0  5.07
 SO SRCPARAM  WASTESP5  7.92692000E-07  0.00  64.17  64.17  30.0  5.07
 SO SRCPARAM  HAULRD1  1.04105000E-05  0.00  30.48  192.51  -15.0  5.91
 SO SRCPARAM  HAULRD2  1.04105000E-05  0.00  30.48  48.12  -30.0  5.91
 SO SRCPARAM  HAULRD3  1.04105000E-05  0.00  30.48  224.59  -40.0  5.91
 SO SRCPARAM  HAULRD4  8.19647000E-06  0.00  30.48  80.21  31.0  5.86
 SO SRCPARAM  HAULRD5  8.19647000E-06  0.00  30.48  192.51  35.0  5.86
 SO SRCPARAM  HAULRD6  8.19647000E-06  0.00  30.48  208.55  30.0  5.86
 SO SRCPARAM  HAULRD7  8.19647000E-06  0.00  30.48  144.38  75.0  5.86
 SO SRCPARAM  HAULRD8  8.19647000E-06  0.00  30.48  144.38  72.0  5.86
 SO SRCPARAM  HAULRD9  2.75168000E-06  0.00  30.48  112.29  150.0  5.38
 SO SRCPARAM  HAULRD10  2.84175000E-06  0.00  30.48  96.25  20.0  5.31
 SO SRCPARAM  HAULRD11  2.75168000E-06  0.00  30.48  208.55  20.0  5.38
 SO SRCPARAM  HAULRD12  2.75168000E-06  0.00  30.48  176.46  20.0  5.38
 SO SRCPARAM  HAULRD13  1.38110000E-06  0.00  30.48  32.08  55.0  4.71
 SO SRCPARAM  HAULRD14  2.75168000E-06  0.00  30.48  192.51  55.0  5.38
 SO SRCPARAM  HAULRD15  2.75168000E-06  0.00  30.48  192.51  30.0  5.38
 SO SRCPARAM  DELIRD1  6.27708000E-07  0.00  9.14  91.40  30.0  2.52
 SO SRCPARAM  DELIRD2  6.27708000E-07  0.00  9.14  91.40  119.0  2.52
```



```
 SO SRCPARAM  DELIRD3  6.27708000E-07  0.00  9.14  91.40  119.0  2.52
 SO SRCPARAM  DELIRD4  6.27708000E-07  0.00  9.14  91.40  119.0  2.52
 SO SRCPARAM  DELIRD5  6.27708000E-07  0.00  9.14  91.40  50.0  2.52
 SO SRCPARAM  DELIRD6  6.27708000E-07  0.00  9.14  91.40  50.0  2.52
 SO SRCPARAM  DELIRD7  6.27708000E-07  0.00  9.14  91.40  88.0  2.52
 SO SRCPARAM  DELIRD8  6.27708000E-07  0.00  9.14  91.40  64.0  2.52
 SO SRCPARAM  DELIRD9  6.27708000E-07  0.00  9.14  91.40  64.0  2.52
 SO SRCPARAM  DELIRD10  6.27708000E-07  0.00  9.14  91.40  30.0  2.52
 SO SRCPARAM  DELIRD11  6.27708000E-07  0.00  9.14  91.40  30.0  2.52
 SO SRCPARAM  DELIRD12  6.27708000E-07  0.00  9.14  91.40  29.0  2.52
 SO SRCPARAM  DELIRD13  6.27708000E-07  0.00  9.14  64.17  110.0  2.52
 SO SRCPARAM  LIMEAPPL  3.81064000E-05  0.00  1.52  3.05  30.0  6.10
 SO SRCPARAM  LIMEHOPP  3.76736900E-03  0.00  0.91  0.91  30.0  6.10
 SO SRCPARAM  ANSILOUN  9.41842000E-04  0.00  0.91  0.91  0.0  3.05
 SO SRCPARAM  WESTPIT  1.41537000E-06  6.00  581.86  581.86  62100000.0  30.0
 SO PARTDIAM  WESTPIT  10
 SO MASSFRAX  WESTPIT  1
 SO PARTDENS  WESTPIT  2.5
 SO CONCUNIT  1.00E+06  GRAMS/SEC  MICROGRAMS/M**3
 SO SRCGROUP  ALL
 SO FINISHED

 RE STARTING
 RE ELEVUNIT  FEET
 RE GRIDCART CART1 STA
 RE GRIDCART CART1 XYINC  699000  19  1000  3642000  19  1000
 RE GRIDCART CART1 ELEV  1  535.0  530.0  560.7  613.0  698.3  977.3  1007.0
 RE GRIDCART CART1 ELEV  1  1468.5  1558.3  996.0  862.0  821.0  291.0  264.0
 RE GRIDCART CART1 ELEV  1  224.0  210.0  193.0  203.0  204.0
 RE GRIDCART CART1 ELEV  2  541.0  552.2  593.8  634.3  703.9  994.8  985.7
 RE GRIDCART CART1 ELEV  2  1315.5  1227.5  940.3  922.2  980.2  340.7  278.5
 RE GRIDCART CART1 ELEV  2  215.8  201.0  210.0  215.0  211.0
 RE GRIDCART CART1 ELEV  3  554.3  573.0  610.8  657.7  742.6  824.7  817.3
 RE GRIDCART CART1 ELEV  3  859.0  950.1  834.3  866.9  873.6  276.3  236.2
 RE GRIDCART CART1 ELEV  3  218.2  207.7  216.4  225.6  225.0
 RE GRIDCART CART1 ELEV  4  576.0  592.0  618.7  665.0  729.0  757.7  758.0
 RE GRIDCART CART1 ELEV  4  800.8  882.7  900.0  856.0  851.3  240.0  233.7
 RE GRIDCART CART1 ELEV  4  220.0  219.0  228.3  246.0  257.0
 RE GRIDCART CART1 ELEV  5  583.0  603.6  626.6  663.0  677.7  705.4  737.0
 RE GRIDCART CART1 ELEV  5  753.4  781.0  826.0  819.2  816.4  238.3  226.2
 RE GRIDCART CART1 ELEV  5  225.0  234.0  237.2  256.4  257.0
 RE GRIDCART CART1 ELEV  6  592.0  624.0  636.0  636.7  655.0  670.2  703.7
 RE GRIDCART CART1 ELEV  6  722.0  731.4  762.3  772.4  780.8  246.0  244.2
 RE GRIDCART CART1 ELEV  6  237.2  247.7  246.8  255.4  264.7
 RE GRIDCART CART1 ELEV  7  644.0  644.3  653.3  668.0  679.7  694.7  705.0
 RE GRIDCART CART1 ELEV  7  729.8  731.7  755.0  772.0  806.7  254.0  255.3
 RE GRIDCART CART1 ELEV  7  253.7  254.0  258.0  267.7  276.0
 RE GRIDCART CART1 ELEV  8  632.3  671.6  670.4  697.7  702.4  729.0  729.3
 RE GRIDCART CART1 ELEV  8  744.0  755.2  767.0  786.8  786.5  262.3  274.2
 RE GRIDCART CART1 ELEV  8  259.2  275.3  281.8  285.1  302.7
 RE GRIDCART CART1 ELEV  9  678.3  708.6  727.1  708.7  765.0  766.8  784.7
 RE GRIDCART CART1 ELEV  9  767.8  776.5  793.0  797.4  813.8  256.0  267.2
 RE GRIDCART CART1 ELEV  9  287.8  257.7  245.2  249.5  281.0
 RE GRIDCART CART1 ELEV  10  691.0  734.3  750.0  767.0  790.3  856.7  860.0
 RE GRIDCART CART1 ELEV  10  821.7  822.0  812.0  832.7  861.3  247.0  226.7
 RE GRIDCART CART1 ELEV  10  258.7  237.0  221.7  220.7  243.0
 RE GRIDCART CART1 ELEV  11  708.0  733.4  803.2  778.3  836.2  899.6  881.7
 RE GRIDCART CART1 ELEV  11  834.3  832.8  871.7  874.2  896.5  264.7  238.2
 RE GRIDCART CART1 ELEV  11  232.0  202.3  217.0  234.9  285.0
 RE GRIDCART CART1 ELEV  12  723.3  738.4  756.6  785.3  880.4  942.0  895.0
 RE GRIDCART CART1 ELEV  12  869.8  885.2  908.0  958.7  937.2  288.0  253.5
 RE GRIDCART CART1 ELEV  12  198.8  217.7  199.5  177.7  192.7
 RE GRIDCART CART1 ELEV  13  770.0  781.3  799.7  821.0  864.7  863.3  990.0
 RE GRIDCART CART1 ELEV  13  941.0  926.3  948.0  977.3  1036.8  364.0  343.0
 RE GRIDCART CART1 ELEV  13  300.3  199.0  161.0  196.0  153.0
 RE GRIDCART CART1 ELEV  14  780.0  792.0  833.8  873.0  920.3  973.5  943.3
 RE GRIDCART CART1 ELEV  14  998.9  940.3  1031.3  1043.4  1064.9  351.7  287.3
 RE GRIDCART CART1 ELEV  14  251.7  210.0  165.0  168.8  153.0
 RE GRIDCART CART1 ELEV  15  817.3  853.6  858.0  927.0  1021.1  1029.2  1062.3
 RE GRIDCART CART1 ELEV  15  1056.0  1114.8  1055.7  854.2  770.7  222.7  212.4
 RE GRIDCART CART1 ELEV  15  214.1  179.7  188.5  105.4  170.3
 RE GRIDCART CART1 ELEV  16  858.0  907.7  903.3  927.0  1066.7  1463.7  1397.0
 RE GRIDCART CART1 ELEV  16  1558.3  1179.7  1222.0  992.0  1298.7  256.0  237.7
 RE GRIDCART CART1 ELEV  16  164.7  169.0  125.0  157.7  139.0
 RE GRIDCART CART1 ELEV  17  893.3  934.0  1033.3  1347.7  1484.2  1762.1  1702.0
 RE GRIDCART CART1 ELEV  17  1413.1  1193.4  1271.7  1157.1  951.0  308.3  208.3
 RE GRIDCART CART1 ELEV  17  198.1  132.7  102.0  125.3  93.3
 RE GRIDCART CART1 ELEV  18  1127.0  1056.1  1073.0  1344.0  1980.0  1647.8  1286.7
 RE GRIDCART CART1 ELEV  18  1076.2  1312.5  1163.3  978.2  778.5  293.3  176.2
 RE GRIDCART CART1 ELEV  18  147.0  121.0  116.7  90.6  62.0
 RE GRIDCART CART1 ELEV  19  1184.0  1148.3  1469.7  1862.0  1526.3  1248.3  1136.0
 RE GRIDCART CART1 ELEV  19  1095.3  954.0  881.0  725.3  620.5  195.0  156.7
 RE GRIDCART CART1 ELEV  19  134.3  114.0  87.0  65.3  59.0
 RE GRIDCART CART1 END
 RE GRIDCART CART2 STA
 RE GRIDCART CART2 XYINC  704000  21  250  3648000  21  250
 RE GRIDCART CART2 ELEV  1  694.7  702.0  697.3  707.0  705.0  704.0  713.0
 RE GRIDCART CART2 ELEV  1  700.0  729.8  733.7  716.0  727.0  731.7  733.0
 RE GRIDCART CART2 ELEV  1  741.7  747.3  755.0  765.0  768.0  765.0  772.0
 RE GRIDCART CART2 ELEV  2  700.2  706.3  702.3  710.6  710.0  711.0  716.0
 RE GRIDCART CART2 ELEV  2  731.3  727.4  729.4  729.3  736.4  740.2  734.3
 RE GRIDCART CART2 ELEV  2  747.4  751.4  755.7  752.6  764.0  770.0  778.0
 RE GRIDCART CART2 ELEV  3  708.6  715.0  712.3  710.7  711.3  729.3  722.5
 RE GRIDCART CART2 ELEV  3  730.3  729.0  731.6  732.0  739.6  744.2  741.0
 RE GRIDCART CART2 ELEV  3  754.5  760.4  765.3  762.8  767.6  771.3  777.4
 RE GRIDCART CART2 ELEV  4  716.0  721.0  705.3  720.0  733.0  720.3  725.0
```

```
RE GRIDCART CART2 ELEV  4  729.0  737.0  740.3  740.0  747.0  751.0  753.0
RE GRIDCART CART2 ELEV  4  762.0  761.0  766.0  768.3  776.0  779.0  785.0
RE GRIDCART CART2 ELEV  5  729.0  730.7  717.6  724.4  729.3  728.8  733.2
RE GRIDCART CART2 ELEV  5  738.0  744.0  746.4  746.0  751.2  755.2  745.0
RE GRIDCART CART2 ELEV  5  759.6  763.8  767.0  772.0  778.0  781.0  786.8
RE GRIDCART CART2 ELEV  6  735.7  730.7  727.4  732.2  733.0  732.8  736.8
RE GRIDCART CART2 ELEV  6  742.7  748.4  750.8  750.7  755.6  759.8  773.3
RE GRIDCART CART2 ELEV  6  765.2  770.2  774.3  781.4  785.6  789.7  795.4
RE GRIDCART CART2 ELEV  7  737.7  738.0  741.3  759.3  738.0  739.3  744.0
RE GRIDCART CART2 ELEV  7  753.0  755.0  766.0  742.0  756.7  759.3  773.0
RE GRIDCART CART2 ELEV  7  767.0  772.7  777.0  787.0  791.0  795.0  803.0
RE GRIDCART CART2 ELEV  8  739.4  740.3  746.2  770.3  741.7  743.2  749.2
RE GRIDCART CART2 ELEV  8  758.3  767.9  773.9  775.0  771.1  764.7  769.0
RE GRIDCART CART2 ELEV  8  779.4  785.4  790.7  785.1  797.5  793.0  815.6
RE GRIDCART CART2 ELEV  9  766.8  736.3  745.6  756.7  784.7  762.3  758.0
RE GRIDCART CART2 ELEV  9  766.7  767.8  772.0  772.0  776.6  776.5  780.0
RE GRIDCART CART2 ELEV  9  788.0  790.6  793.0  815.1  806.0  806.7  797.4
RE GRIDCART CART2 ELEV 10  817.0  747.0  747.3  758.3  779.0  767.0  772.3
RE GRIDCART CART2 ELEV 10  778.0  777.0  778.7  779.0  783.0  783.3  784.0
RE GRIDCART CART2 ELEV 10  791.3  792.7  794.0  793.7  807.0  807.0  809.0
RE GRIDCART CART2 ELEV 11  835.6  766.0  776.2  772.2  775.7  783.0  799.4
RE GRIDCART CART2 ELEV 11  792.3  785.5  782.1  780.7  783.8  783.5  781.7
RE GRIDCART CART2 ELEV 11  795.8  790.9  793.3  796.8  812.6  816.0  821.0
RE GRIDCART CART2 ELEV 12  853.0  794.0  785.0  794.0  772.0  780.6  778.8
RE GRIDCART CART2 ELEV 12  805.3  797.4  794.4  783.0  795.7  812.7  792.0
RE GRIDCART CART2 ELEV 12  813.8  816.7  812.3  800.4  814.4  819.3  825.6
RE GRIDCART CART2 ELEV 13  856.7  782.0  783.3  860.3  860.0  787.0  778.3
RE GRIDCART CART2 ELEV 13  806.0  821.7  821.0  804.0  788.0  822.0  800.0
RE GRIDCART CART2 ELEV 13  810.0  809.7  812.0  813.3  826.0  829.0  832.7
RE GRIDCART CART2 ELEV 14  866.1  823.7  856.4  789.9  873.3  808.3  786.2
RE GRIDCART CART2 ELEV 14  807.0  826.3  830.2  803.0  811.6  823.4  828.3
RE GRIDCART CART2 ELEV 14  824.0  814.6  818.3  823.2  836.8  829.0  828.6
RE GRIDCART CART2 ELEV 15  861.6  829.3  883.0  799.0  898.3  857.4  851.9
RE GRIDCART CART2 ELEV 15  819.7  823.8  847.7  816.3  812.0  823.8  842.3
RE GRIDCART CART2 ELEV 15  846.1  832.6  823.3  827.0  857.0  856.0  846.4
RE GRIDCART CART2 ELEV 16  889.3  832.0  908.0  866.7  810.0  891.0  898.7
RE GRIDCART CART2 ELEV 16  819.0  832.2  857.7  823.0  823.3  826.0  862.0
RE GRIDCART CART2 ELEV 16  855.7  853.3  860.0  839.7  862.3  872.0  870.3
RE GRIDCART CART2 ELEV 17  899.6  822.7  827.8  937.3  881.7  871.8  915.9
RE GRIDCART CART2 ELEV 17  838.3  834.3  845.1  825.0  836.3  832.8  852.3
RE GRIDCART CART2 ELEV 17  860.4  862.2  871.7  878.1  885.4  862.0  874.2
RE GRIDCART CART2 ELEV 18  898.7  866.3  902.3  915.3  874.0  905.8  938.0
RE GRIDCART CART2 ELEV 18  857.3  853.5  852.2  846.7  879.7  906.8  954.0
RE GRIDCART CART2 ELEV 18  856.3  874.6  885.7  869.6  884.9  899.0  892.3
RE GRIDCART CART2 ELEV 19  909.0  852.0  926.3  940.0  874.0  867.0  919.0
RE GRIDCART CART2 ELEV 19  864.0  857.4  858.7  843.0  887.7  881.7  862.0
RE GRIDCART CART2 ELEV 19  865.0  864.7  906.0  866.7  905.3  927.0  902.0
RE GRIDCART CART2 ELEV 20  926.9  905.0  921.5  937.7  865.7  901.2  898.9
RE GRIDCART CART2 ELEV 20  881.7  857.8  868.6  885.0  853.5  889.7  871.3
RE GRIDCART CART2 ELEV 20  909.5  882.9  903.3  904.1  908.2  937.3  941.0
RE GRIDCART CART2 ELEV 21  942.0  935.7  881.7  919.2  895.0  908.7  896.5
RE GRIDCART CART2 ELEV 21  895.7  869.8  869.0  898.0  887.3  885.2  917.0
RE GRIDCART CART2 ELEV 21  903.3  881.2  908.0  967.8  936.2  906.0  958.7
RE GRIDCART CART2 END
RE DISCCART  705006.0  3649827.0  748.69
RE DISCCART  705031.0  3649872.0  753.28
RE DISCCART  705055.0  3649915.0  757.87
RE DISCCART  705080.0  3649960.0  761.15
RE DISCCART  705096.0  3650006.0  761.81
RE DISCCART  705116.0  3650031.0  761.81
RE DISCCART  705123.0  3650081.0  763.78
RE DISCCART  705137.0  3650129.0  762.14
RE DISCCART  705152.0  3650178.0  771.0
RE DISCCART  705166.0  3650226.0  763.78
RE DISCCART  705192.0  3650281.0  766.08
RE DISCCART  705214.0  3650326.0  768.7
RE DISCCART  705235.0  3650358.0  776.57
RE DISCCART  705276.0  3650407.0  783.46
RE DISCCART  705324.0  3650427.0  785.43
RE DISCCART  705371.0  3650450.0  787.07
RE DISCCART  705436.0  3650479.0  795.93
RE DISCCART  705471.0  3650519.0  796.92
RE DISCCART  705511.0  3650564.0  796.92
RE DISCCART  705516.0  3650614.0  792.32
RE DISCCART  705511.0  3650665.0  787.73
RE DISCCART  705505.0  3650698.0  783.79
RE DISCCART  705488.0  3650739.0  779.2
RE DISCCART  705473.0  3650788.0  776.57
RE DISCCART  705472.0  3650844.0  770.67
RE DISCCART  705483.0  3650898.0  771.98
RE DISCCART  705494.0  3650948.0  777.23
RE DISCCART  705505.0  3650998.0  778.54
RE DISCCART  705518.0  3651047.0  779.53
RE DISCCART  705530.0  3651095.0  785.43
RE DISCCART  705542.0  3651145.0  786.42
RE DISCCART  705554.0  3651191.0  782.15
RE DISCCART  705569.0  3651251.0  783.14
RE DISCCART  705586.0  3651309.0  786.75
RE DISCCART  705595.0  3651402.0  797.9
RE DISCCART  705602.0  3651434.0  798.88
RE DISCCART  705625.0  3651479.0  799.54
RE DISCCART  705653.0  3651519.0  816.6
RE DISCCART  705682.0  3651561.0  812.66
RE DISCCART  705706.0  3651599.0  812.34
RE DISCCART  705735.0  3651666.0  815.62
RE DISCCART  705739.0  3651716.0  817.59
```



```
RE DISCCART  705742.0  3651765.0  817.91
RE DISCCART  705745.0  3651816.0  818.57
RE DISCCART  705748.0  3651867.0  818.9
RE DISCCART  705752.0  3651918.0  822.83
RE DISCCART  705755.0  3651966.0  832.35
RE DISCCART  705758.0  3652015.0  841.21
RE DISCCART  705807.0  3652015.0  828.41
RE DISCCART  705857.0  3652015.0  822.18
RE DISCCART  705907.0  3652015.0  833.33
RE DISCCART  705957.0  3652015.0  842.19
RE DISCCART  706007.0  3652016.0  834.97
RE DISCCART  706059.0  3652016.0  831.69
RE DISCCART  706107.0  3652016.0  836.94
RE DISCCART  706157.0  3652016.0  858.27
RE DISCCART  706207.0  3652017.0  856.63
RE DISCCART  706247.0  3652017.0  846.13
RE DISCCART  706282.0  3651984.0  831.69
RE DISCCART  706322.0  3651951.0  824.48
RE DISCCART  706357.0  3651916.0  823.49
RE DISCCART  706394.0  3651882.0  822.51
RE DISCCART  706430.0  3651849.0  820.54
RE DISCCART  706467.0  3651815.0  819.23
RE DISCCART  706504.0  3651781.0  823.49
RE DISCCART  706542.0  3651746.0  832.02
RE DISCCART  706580.0  3651710.0  850.07
RE DISCCART  706617.0  3651677.0  834.65
RE DISCCART  706668.0  3651663.0  840.55
RE DISCCART  706716.0  3651652.0  840.22
RE DISCCART  706765.0  3651639.0  828.08
RE DISCCART  706814.0  3651627.0  822.51
RE DISCCART  706863.0  3651614.0  815.62
RE DISCCART  706912.0  3651603.0  814.3
RE DISCCART  706961.0  3651590.0  819.55
RE DISCCART  707010.0  3651578.0  823.16
RE DISCCART  707057.0  3651567.0  820.54
RE DISCCART  707106.0  3651554.0  819.55
RE DISCCART  707155.0  3651542.0  830.05
RE DISCCART  707203.0  3651529.0  848.1
RE DISCCART  707256.0  3651512.0  840.55
RE DISCCART  707299.0  3651539.0  831.04
RE DISCCART  707320.0  3651573.0  833.01
RE DISCCART  707370.0  3651574.0  833.01
RE DISCCART  707421.0  3651576.0  851.05
RE DISCCART  707471.0  3651578.0  853.67
RE DISCCART  707529.0  3651579.0  856.96
RE DISCCART  707562.1  3651552.0  850.72
RE DISCCART  707574.0  3651496.0  842.19
RE DISCCART  707609.0  3651459.0  839.57
RE DISCCART  707663.0  3651415.0  832.02
RE DISCCART  707712.0  3651400.0  829.72
RE DISCCART  707761.0  3651389.0  826.77
RE DISCCART  707810.0  3651377.0  823.16
RE DISCCART  707857.0  3651364.0  819.88
RE DISCCART  707906.0  3651353.0  815.29
RE DISCCART  707955.0  3651340.0  815.94
RE DISCCART  708005.0  3651329.0  819.23
RE DISCCART  708053.0  3651316.0  819.88
RE DISCCART  708104.0  3651304.0  823.16
RE DISCCART  708152.0  3651291.0  824.48
RE DISCCART  708187.0  3651283.0  825.46
RE DISCCART  708187.0  3651233.0  823.16
RE DISCCART  708186.0  3651183.0  821.52
RE DISCCART  708186.0  3651133.0  819.88
RE DISCCART  708186.0  3651083.0  817.91
RE DISCCART  708186.0  3651033.0  815.62
RE DISCCART  708186.0  3650983.0  814.3
RE DISCCART  708186.0  3650933.0  812.99
RE DISCCART  708186.0  3650883.0  812.34
RE DISCCART  708186.0  3650833.0  812.66
RE DISCCART  708186.0  3650783.0  809.38
RE DISCCART  708186.0  3650733.0  801.84
RE DISCCART  708186.0  3650683.0  797.9
RE DISCCART  708186.0  3650633.0  799.54
RE DISCCART  708186.0  3650583.0  802.17
RE DISCCART  708186.0  3650533.0  802.17
RE DISCCART  708186.0  3650483.0  801.51
RE DISCCART  708186.0  3650433.0  801.84
RE DISCCART  708186.0  3650383.0  799.21
RE DISCCART  708186.0  3650333.0  802.82
RE DISCCART  708186.0  3650283.0  805.12
RE DISCCART  708186.0  3650233.0  806.43
RE DISCCART  708186.0  3650183.0  804.79
RE DISCCART  708186.0  3650131.0  800.52
RE DISCCART  708135.0  3650102.0  790.68
RE DISCCART  708091.0  3650076.0  785.76
RE DISCCART  708046.0  3650050.0  791.01
RE DISCCART  708003.0  3650026.0  793.31
RE DISCCART  707960.0  3650001.0  792.98
RE DISCCART  707915.0  3649976.0  792.32
RE DISCCART  707872.0  3649950.0  791.67
RE DISCCART  707830.0  3649927.0  791.01
RE DISCCART  707787.0  3649902.0  789.37
RE DISCCART  707744.0  3649877.0  786.75
RE DISCCART  707701.0  3649852.0  783.79
RE DISCCART  707657.0  3649827.0  782.15
RE DISCCART  707613.0  3649802.0  782.15
```

```
RE DISCCART  707570.0  3649777.0  781.17
RE DISCCART  707525.0  3649752.0  779.86
RE DISCCART  707481.0  3649726.0  777.89
RE DISCCART  707425.0  3649695.0  769.03
RE DISCCART  707400.0  3649644.0  768.04
RE DISCCART  707372.0  3649585.0  765.09
RE DISCCART  707349.0  3649536.0  764.76
RE DISCCART  707327.0  3649490.0  774.93
RE DISCCART  707305.0  3649445.0  761.81
RE DISCCART  707282.0  3649398.0  763.12
RE DISCCART  707259.0  3649351.0  764.44
RE DISCCART  707235.0  3649303.0  774.93
RE DISCCART  707212.0  3649255.0  767.06
RE DISCCART  707173.0  3649227.0  753.94
RE DISCCART  707133.0  3649200.0  759.84
RE DISCCART  707094.0  3649171.0  761.15
RE DISCCART  707051.0  3649141.0  748.03
RE DISCCART  707001.0  3649141.0  758.53
RE DISCCART  706951.0  3649141.0  757.87
RE DISCCART  706901.0  3649141.0  755.58
RE DISCCART  706871.0  3649141.0  753.94
RE DISCCART  706861.0  3649093.0  750.98
RE DISCCART  706857.0  3649043.0  750.98
RE DISCCART  706851.0  3649000.0  750.98
RE DISCCART  706833.0  3648963.0  750.98
RE DISCCART  706792.0  3648936.0  750.33
RE DISCCART  706749.0  3648908.0  749.67
RE DISCCART  706706.0  3648881.0  745.41
RE DISCCART  706662.0  3648854.0  744.42
RE DISCCART  706617.0  3648825.0  744.75
RE DISCCART  706567.0  3648825.0  742.78
RE DISCCART  706517.0  3648825.0  742.45
RE DISCCART  706467.0  3648825.0  743.11
RE DISCCART  706417.0  3648825.0  742.45
RE DISCCART  706367.0  3648825.0  742.13
RE DISCCART  706321.0  3648825.0  743.11
RE DISCCART  706283.7  3648839.0  743.77
RE DISCCART  706258.0  3648852.0  743.11
RE DISCCART  706213.0  3648877.0  742.45
RE DISCCART  706169.0  3648901.0  742.13
RE DISCCART  706122.0  3648928.0  743.44
RE DISCCART  706075.0  3648957.0  743.77
RE DISCCART  706031.0  3648981.0  743.44
RE DISCCART  705984.0  3649007.0  743.77
RE DISCCART  705940.0  3649031.0  743.44
RE DISCCART  705892.1  3649055.0  740.16
RE DISCCART  705853.0  3649079.0  740.16
RE DISCCART  705809.0  3649105.0  740.81
RE DISCCART  705766.0  3649128.0  740.49
RE DISCCART  705723.0  3649154.0  740.16
RE DISCCART  705679.0  3649177.0  737.86
RE DISCCART  705636.0  3649202.0  736.22
RE DISCCART  705594.0  3649225.0  735.89
RE DISCCART  705558.0  3649245.0  736.22
RE DISCCART  705576.0  3649291.0  741.47
RE DISCCART  705596.0  3649338.0  742.13
RE DISCCART  705615.0  3649385.0  743.44
RE DISCCART  705634.0  3649432.0  746.06
RE DISCCART  705651.0  3649475.0  747.38
RE DISCCART  705609.0  3649499.0  746.06
RE DISCCART  705564.0  3649523.0  743.77
RE DISCCART  705519.0  3649547.0  743.44
RE DISCCART  705476.0  3649571.0  744.42
RE DISCCART  705431.0  3649596.0  743.77
RE DISCCART  705383.0  3649622.0  741.47
RE DISCCART  705341.0  3649645.0  741.14
RE DISCCART  705296.0  3649669.0  741.14
RE DISCCART  705253.0  3649693.0  740.81
RE DISCCART  705207.0  3649717.0  740.81
RE DISCCART  705161.0  3649741.0  739.5
RE DISCCART  705117.0  3649766.0  740.49
RE DISCCART  705076.0  3649789.0  746.06
RE DISCCART  705033.0  3649812.0  750.0
RE DISCCART  705586.0  3651364.0  798.88
RE FINISHED

ME STARTING
ME INPUTFIL  C:\TRINITY\YUMTUS89.ASC
ME ANEMHGHT  10.0  METERS
ME SURFDATA  3145  1989
ME UAIRDATA  23160  1989
ME STARTEND  89  01  01  1  89  12  31  24
ME FINISHED

OU STARTING
OU FINISHED

**********************************
*** SETUP Finishes Successfully ***
**********************************
```



```
 *** ISCST3 - VERSION 96113 ***     ***  IMPERIAL PROJECT PM-10 IMPACT ASSESSMENT                          ***        08/09/96
                                   ***  AVG. ANNUAL IMPACTS - 1000 M/250 M GRIDS & DISCRETE RECEPTORS     ***        13:13:19
                                                                                                                   PAGE    1
**MODELOPTs: CONC                          RURAL   ELEV           DFAULT

                                             ***     MODEL SETUP OPTIONS SUMMARY       ***
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -

**Intermediate Terrain Processing is Selected

**Model Is Setup For Calculation of Average CONCentration Values.

  --  SCAVENGING/DEPOSITION LOGIC --
**Model Uses NO DRY DEPLETION.  DDPLETE = F
**Model Uses NO WET DEPLETION.  WDPLETE = F
**NO WET SCAVENGING Data Provided.
**Model Does NOT Use GRIDDED TERRAIN Data for Depletion Calculations

**Model Uses RURAL Dispersion.

**Model Uses Regulatory DEFAULT Options:
          1. Final Plume Rise.
          2. Stack-tip Downwash.
          3. Buoyancy-induced Dispersion.
          4. Use Calms Processing Routine.
          5. Not Use Missing Data Processing Routine.
          6. Default Wind Profile Exponents.
          7. Default Vertical Potential Temperature Gradients.
          8. 'Upper Bound' Values for Supersquat Buildings.
          9. No Exponential Decay for RURAL Mode

**Model Accepts Receptors on ELEV Terrain.

**Model Assumes No FLAGPOLE Receptor Heights.

**Model Calculates PERIOD Averages Only

**This Run Includes:   43 Source(s);      1 Source Group(s); and   1014 Receptor(s)

**The Model Assumes A Pollutant Type of:  PM10

**Model Set To Continue RUNning After the Setup Testing.

**Output Options Selected:
        Model Outputs Tables of PERIOD Averages by Receptor

**NOTE:  The Following Flags May Appear Following CONC Values:  c for Calm Hours
                                                                m for Missing Hours
                                                                b for Both Calm and Missing Hours

**Misc. Inputs:  Anem. Hgt. (m) =    10.00 ;    Decay Coef. =     .0000     ;    Rot. Angle =      .0
                 Emission Units = GRAMS/SEC                                 ;  Emission Rate Unit Factor =    .10000E+07
                 Output Units   = MICROGRAMS/M**3

**Input Runstream File: C:\TRINITY\0959XI37.DAT                ;  **Output Print File: C:\TRINITY\0959XI37.LST
**File for Saving Result Arrays: SAVE1.FIL
**Detailed Error/Message File:   ERROR.LST
```

**MODELOPTs: CONC RURAL ELEV DFAULT

*** POINT SOURCE DATA ***

SOURCE ID	NUMBER PART. CATS.	EMISSION RATE (GRAMS/SEC)	X (METERS)	Y (METERS)	BASE ELEV. (METERS)	STACK HEIGHT (METERS)	STACK TEMP. (DEG.K)	STACK EXIT VEL. (M/SEC)	STACK DIAMETER (METERS)	BUILDING EXISTS	EMISSION RATE SCALAR VARY BY
ANSILOLD	0	.78750E-03	706591.0	3650227.0	243.8	22.16	299.81	8.17	.20	NO	
LIMELOAD	0	.21263E-03	706572.0	3650230.0	243.8	22.16	299.81	8.17	.20	NO	
JAWCRUSH	0	.38053E-03	705358.0	3649725.0	231.7	4.57	299.81	.01	1.83	NO	
PULVERIZ	0	.38053E-03	705344.0	3649697.0	231.7	1.52	299.81	.01	1.83	NO	
DIESGENR	0	.20311E-03	705549.0	3649588.0	231.7	3.05	322.04	21.34	.20	NO	

**MODELOPTs: CONC RURAL ELEV DFAULT

*** AREA SOURCE DATA ***

SOURCE ID	NUMBER PART. CATS.	EMISSION RATE (GRAMS/SEC /METER**2)	COORD (SW CORNER) X (METERS)	Y (METERS)	BASE ELEV. (METERS)	RELEASE HEIGHT (METERS)	X-DIM OF AREA (METERS)	Y-DIM OF AREA (METERS)	ORIENT. OF AREA (DEG.)	INIT. SZ (METERS)	EMISSION RATE SCALAR VARY BY
HEAPAREA	0	.79955E-06	706070.0	3649505.0	274.3	.00	700.00	273.98	30.00	4.56	
WASTESP1	0	.79269E-06	705324.0	3649918.0	289.6	.00	333.33	916.69	30.00	5.07	
WASTESP2	0	.79269E-06	705727.0	3649955.0	289.6	.00	160.42	641.68	30.00	5.07	
WASTESP3	0	.79269E-06	705969.0	3650067.0	289.6	.00	96.25	417.09	30.00	5.07	
WASTESP4	0	.79269E-06	706081.0	3650067.0	289.6	.00	48.12	304.80	30.00	5.07	
WASTESP5	0	.79269E-06	705936.0	3650003.0	289.6	.00	64.17	64.17	30.00	5.07	
HAULRD1	0	.10410E-04	706354.0	3650693.0	249.9	.00	30.48	192.51	-15.00	5.91	
HAULRD2	0	.10410E-04	706386.0	3650629.0	249.9	.00	30.48	48.12	-30.00	5.91	
HAULRD3	0	.10410E-04	706530.0	3650453.0	249.9	.00	30.48	224.59	-40.00	5.91	
HAULRD4	0	.81965E-05	706450.0	3650405.0	249.9	.00	30.48	80.21	31.00	5.86	
HAULRD5	0	.81965E-05	706337.0	3650260.0	259.1	.00	30.48	192.51	35.00	5.86	
HAULRD6	0	.81965E-05	706225.0	3650068.0	274.3	.00	30.48	208.55	30.00	5.86	
HAULRD7	0	.81965E-05	706065.0	3650020.0	281.9	.00	30.48	144.38	75.00	5.86	
HAULRD8	0	.81965E-05	705904.0	3649971.0	289.6	.00	30.48	144.38	72.00	5.86	
HAULRD9	0	.27517E-05	706556.0	3650468.0	243.8	.00	30.48	112.29	150.00	5.38	
HAULRD10	0	.28417E-05	706562.0	3650285.0	243.8	.00	30.48	96.25	20.00	5.31	
HAULRD11	0	.27517E-05	706482.0	3650116.0	243.8	.00	30.48	208.55	20.00	5.38	
HAULRD12	0	.27517E-05	706418.0	3649939.0	243.8	.00	30.48	176.46	20.00	5.38	
HAULRD13	0	.13811E-05	706386.0	3649923.0	243.8	.00	30.48	32.08	55.00	4.71	
HAULRD14	0	.27517E-05	706229.0	3649812.0	243.8	.00	30.48	192.51	55.00	5.38	
HAULRD15	0	.27517E-05	706128.0	3649658.0	243.8	.00	30.48	192.51	30.00	5.38	
DELIRD1	0	.62771E-06	705010.0	3649832.0	243.8	.00	9.14	91.40	30.00	2.52	
DELIRD2	0	.62771E-06	705083.0	3649923.0	243.8	.00	9.14	91.40	119.00	2.52	
DELIRD3	0	.62771E-06	705240.0	3649830.0	243.8	.00	9.14	91.40	119.00	2.52	
DELIRD4	0	.62771E-06	705407.0	3649734.0	243.8	.00	9.14	91.40	119.00	2.52	
DELIRD5	0	.62771E-06	705544.0	3649641.0	243.8	.00	9.14	91.40	50.00	2.52	
DELIRD6	0	.62771E-06	705690.0	3649761.0	243.8	.00	9.14	91.40	50.00	2.52	
DELIRD7	0	.62771E-06	705825.0	3649872.0	243.8	.00	9.14	91.40	88.00	2.52	
DELIRD8	0	.62771E-06	705987.0	3649879.0	243.8	.00	9.14	91.40	64.00	2.52	
DELIRD9	0	.62771E-06	706146.0	3649953.0	243.8	.00	9.14	91.40	64.00	2.52	
DELIRD10	0	.62771E-06	706303.0	3650027.0	243.8	.00	9.14	91.40	30.00	2.52	
DELIRD11	0	.62771E-06	706400.0	3650194.0	243.8	.00	9.14	91.40	30.00	2.52	
DELIRD12	0	.62771E-06	706464.0	3650308.0	243.8	.00	9.14	91.40	29.00	2.52	
DELIRD13	0	.62771E-06	706528.0	3650420.0	243.8	.00	9.14	64.17	110.00	2.52	
LIMEAPPL	0	.38106E-04	706555.0	3650237.0	243.8	.00	1.52	3.05	30.00	6.10	
LIMEHOPP	0	.37674E-02	706571.0	3650231.0	243.8	.00	.91	.91	30.00	6.10	
ANSILOUN	0	.94184E-03	706590.0	3650227.0	243.8	.00	.91	.91	.00	3.05	

**MODELOPTs: CONC RURAL ELEV DFAULT

*** OPENPIT SOURCE DATA ***

SOURCE ID	NUMBER PART. CATS.	EMISSION RATE (GRAMS/SEC /METER**2)	COORD (SW CORNER) X (METERS)	Y (METERS)	BASE ELEV. (METERS)	RELEASE HEIGHT (METERS)	X-DIM OF PIT (METERS)	Y-DIM OF PIT (METERS)	ORIENT. OF PIT (DEG.)	VOLUME OF PIT (M**3)	EMISSION RATE SCALAR VARY BY
WESTPIT	1	.14154E-05	705777.0	3651283.0	249.9	6.00	581.86	581.86	30.00	.62100E+08	

**MODELOPTs: CONC RURAL ELEV DFAULT

*** SOURCE IDs DEFINING SOURCE GROUPS ***

GROUP ID	SOURCE IDs
ALL	ANSILOLD, LIMELOAD, JAWCRUSH, PULVERIZ, DIESGENR, HEAPAREA, WASTESP1, WASTESP2, WASTESP3, WASTESP4, WASTESP5, HAULRD1 , HAULRD2 , HAULRD3 , HAULRD4 , HAULRD5 , HAULRD6 , HAULRD7 , HAULRD8 , HAULRD9 , HAULRD10, HAULRD11, HAULRD12, HAULRD13, HAULRD14, HAULRD15, DELIRD1 , DELIRD2 , DELIRD3 , DELIRD4 , DELIRD5 , DELIRD6 , DELIRD7 , DELIRD8 , DELIRD9 , DELIRD10, DELIRD11, DELIRD12, DELIRD13, LIMEAPPL, LIMEHOPP, ANSILOUN, WESTPIT ,

**MODELOPTs: CONC RURAL ELEV DFAULT

*** SOURCE PARTICULATE/GAS DATA ***

*** SOURCE ID = WESTPIT ; SOURCE TYPE = OPENPIT ***

MASS FRACTION =
1.00000,

PARTICLE DIAMETER (MICRONS) =
10.00000,

PARTICLE DENSITY (G/CM**3) =
2.50000,

**MODELOPTs: CONC RURAL ELEV DFAULT

*** GRIDDED RECEPTOR NETWORK SUMMARY ***

*** NETWORK ID: CART1 ; NETWORK TYPE: GRIDCART ***

*** X-COORDINATES OF GRID ***
(METERS)

699000.0, 700000.0, 701000.0, 702000.0, 703000.0, 704000.0, 705000.0, 706000.0, 707000.0, 708000.0,
709000.0, 710000.0, 711000.0, 712000.0, 713000.0, 714000.0, 715000.0, 716000.0, 717000.0,

*** Y-COORDINATES OF GRID ***
(METERS)

3642000.0, 3643000.0, 3644000.0, 3645000.0, 3646000.0, 3647000.0, 3648000.0, 3649000.0, 3650000.0, 3651000.0,
3652000.0, 3653000.0, 3654000.0, 3655000.0, 3656000.0, 3657000.0, 3658000.0, 3659000.0, 3660000.0,

**MODELOPTs: CONC RURAL ELEV DFAULT

*** NETWORK ID: CART1 ; NETWORK TYPE: GRIDCART ***

* ELEVATION HEIGHTS IN METERS *

Y-COORD (METERS)	X-COORD (METERS) 699000.00	700000.00	701000.00	702000.00	703000.00	704000.00	705000.00	706000.00	707000.00
3660000.00	360.88	350.00	447.96	567.54	465.22	380.48	346.25	333.85	290.78
3659000.00	343.51	321.90	327.05	409.65	603.50	502.25	392.19	328.03	400.05
3658000.00	272.28	284.68	314.95	410.78	452.38	537.09	518.77	430.71	363.75
3657000.00	261.52	276.67	275.33	282.55	325.13	446.14	425.81	474.97	359.57
3656000.00	249.11	260.18	261.52	282.55	311.23	313.70	323.79	321.87	339.79
3655000.00	237.74	241.40	254.14	266.09	280.51	296.72	287.52	304.46	286.60
3654000.00	234.70	238.14	243.75	250.24	263.56	263.13	301.75	286.82	282.34
3653000.00	220.46	225.06	230.61	239.36	268.35	287.12	272.80	265.12	269.81
3652000.00	215.80	223.54	244.82	237.23	254.87	274.20	268.74	254.29	253.84
3651000.00	210.62	223.81	228.60	233.78	240.88	261.12	262.13	250.45	250.55
3650000.00	206.75	215.98	221.62	216.01	233.17	233.72	239.18	234.03	236.68
3649000.00	192.73	204.70	204.34	212.66	214.09	222.20	222.29	226.77	230.18
3648000.00	196.29	196.38	199.13	203.61	207.17	211.74	214.88	222.44	223.02
3647000.00	180.44	190.20	193.85	194.07	199.64	204.28	214.49	220.07	222.93
3646000.00	177.70	183.98	190.99	202.08	206.56	215.01	224.64	229.64	238.05
3645000.00	175.56	180.44	188.58	202.69	222.20	230.95	231.04	244.08	269.05
3644000.00	168.95	174.65	186.17	200.47	226.34	251.37	249.11	261.82	289.59
3643000.00	164.90	168.31	180.99	193.33	214.55	303.22	300.44	400.96	374.14
3642000.00	163.07	161.54	170.90	186.84	212.84	297.88	306.93	447.60	474.97

**MODELOPTs: CONC RURAL ELEV DFAULT

*** NETWORK ID: CART1 ; NETWORK TYPE: GRIDCART ***

* ELEVATION HEIGHTS IN METERS *

Y-COORD (METERS)	X-COORD (METERS) 708000.00	709000.00	710000.00	711000.00	712000.00	713000.00	714000.00	715000.00	716000.00
3660000.00	268.53	221.07	189.13	59.44	47.76	40.93	34.75	26.52	19.90
3659000.00	354.57	298.16	237.29	89.40	53.71	44.81	36.88	35.57	27.61
3658000.00	387.61	352.68	289.86	93.97	63.49	60.38	40.45	31.09	38.19
3657000.00	372.47	302.36	395.84	78.03	72.45	50.20	51.51	38.10	48.07
3656000.00	321.78	260.36	234.91	67.88	64.74	65.26	54.77	57.45	32.13
3655000.00	314.34	318.03	324.58	107.20	87.57	76.72	64.01	50.29	51.45
3654000.00	288.95	297.88	316.02	110.95	104.55	91.53	60.66	49.07	59.74
3653000.00	276.76	292.21	285.66	87.78	77.27	60.59	66.35	60.81	54.16
3652000.00	265.69	266.46	273.25	80.68	72.60	70.71	61.66	66.14	71.60
3651000.00	247.50	253.81	262.52	75.29	69.10	78.85	72.24	67.57	67.27
3650000.00	241.71	243.05	248.05	78.03	81.44	87.72	78.55	74.74	76.05
3649000.00	233.78	239.82	239.73	79.95	83.58	79.00	83.91	85.89	86.90
3648000.00	230.12	235.31	245.88	77.42	77.82	77.33	77.42	78.64	81.59
3647000.00	232.35	235.43	237.99	74.98	74.43	72.30	75.50	75.22	77.85
3646000.00	251.76	249.69	248.84	72.63	68.95	68.58	71.32	72.30	78.15
3645000.00	274.32	260.91	259.48	73.15	71.23	67.06	66.75	69.59	74.98
3644000.00	254.29	264.23	266.27	84.22	71.99	66.51	63.31	65.96	68.76
3643000.00	286.60	281.09	298.76	103.85	84.89	65.78	61.26	64.01	65.53
3642000.00	303.58	262.74	250.24	88.70	80.47	68.28	64.01	58.83	61.87

**MODELOPTs: CONC RURAL ELEV DFAULT

*** NETWORK ID: CART1 ; NETWORK TYPE: GRIDCART ***

* ELEVATION HEIGHTS IN METERS *

Y-COORD (METERS)	X-COORD (METERS) 717000.00
3660000.00	17.98
3659000.00	18.90
3658000.00	28.44
3657000.00	42.37
3656000.00	51.91
3655000.00	46.63
3654000.00	46.63
3653000.00	58.73
3652000.00	86.87
3651000.00	74.07
3650000.00	85.65
3649000.00	92.26
3648000.00	84.12
3647000.00	80.68
3646000.00	78.33
3645000.00	78.33
3644000.00	68.58
3643000.00	64.31
3642000.00	62.18

**MODELOPTs: CONC RURAL ELEV DFAULT

*** GRIDDED RECEPTOR NETWORK SUMMARY ***

*** NETWORK ID: CART2 ; NETWORK TYPE: GRIDCART ***

*** X-COORDINATES OF GRID ***
(METERS)

704000.0, 704250.0, 704500.0, 704750.0, 705000.0, 705250.0, 705500.0, 705750.0, 706000.0, 706250.0,
706500.0, 706750.0, 707000.0, 707250.0, 707500.0, 707750.0, 708000.0, 708250.0, 708500.0, 708750.0,
709000.0,

*** Y-COORDINATES OF GRID ***
(METERS)

3648000.0, 3648250.0, 3648500.0, 3648750.0, 3649000.0, 3649250.0, 3649500.0, 3649750.0, 3650000.0, 3650250.0,
3650500.0, 3650750.0, 3651000.0, 3651250.0, 3651500.0, 3651750.0, 3652000.0, 3652250.0, 3652500.0, 3652750.0,
3653000.0,

**MODELOPTs: CONC RURAL ELEV DFAULT

*** NETWORK ID: CART2 ; NETWORK TYPE: GRIDCART ***

* ELEVATION HEIGHTS IN METERS *

Y-COORD (METERS)	X-COORD (METERS) 704000.00	704250.00	704500.00	704750.00	705000.00	705250.00	705500.00	705750.00	706000.00
3653000.00	287.12	285.20	268.74	280.17	272.80	276.97	273.25	273.01	265.12
3652750.00	282.52	275.84	280.87	285.81	263.87	274.69	273.98	268.74	261.46
3652500.00	277.06	259.69	282.34	286.51	266.40	264.26	280.11	263.35	261.34
3652250.00	273.92	264.05	275.02	278.98	266.40	276.09	285.90	261.31	260.15
3652000.00	274.20	250.76	252.31	285.69	268.74	265.72	279.17	255.51	254.29
3651750.00	271.06	253.59	276.76	264.17	246.89	271.58	273.92	249.63	253.65
3651500.00	263.23	252.77	269.14	243.54	273.80	261.34	259.66	249.84	251.09
3651250.00	263.99	251.06	261.03	240.76	266.18	246.37	239.63	245.97	251.86
3651000.00	261.12	238.35	238.75	262.22	262.13	239.88	237.23	245.67	250.45
3650750.00	259.99	242.01	239.27	242.01	235.31	237.93	237.38	245.46	243.05
3650500.00	254.69	233.48	236.59	235.37	236.43	238.66	243.66	241.49	239.42
3650250.00	249.02	227.69	227.78	231.13	237.44	233.78	235.40	237.13	236.83
3650000.00	233.72	224.42	227.26	230.64	239.18	232.35	231.04	233.69	234.03
3649750.00	225.37	225.64	227.44	234.79	226.07	226.53	228.36	231.13	234.06
3649500.00	224.85	224.94	225.95	231.43	224.94	225.34	226.77	229.51	230.12
3649250.00	224.24	222.72	221.71	223.17	223.42	223.36	224.58	226.37	228.11
3649000.00	222.20	222.72	218.72	220.80	222.29	222.14	223.48	224.94	226.77
3648750.00	218.24	219.76	214.98	219.46	223.42	219.55	220.98	222.20	224.64
3648500.00	215.98	217.93	217.11	216.62	216.80	222.29	220.22	222.60	222.20
3648250.00	213.42	215.28	214.06	216.59	216.41	216.71	218.24	222.90	221.71
3648000.00	211.74	213.97	212.54	215.49	214.88	214.58	217.32	213.36	222.44

**MODELOPTs: CONC RURAL ELEV DFAULT

*** NETWORK ID: CART2 ; NETWORK TYPE: GRIDCART ***

* ELEVATION HEIGHTS IN METERS *

Y-COORD (METERS)	X-COORD (METERS) 706250.00	706500.00	706750.00	707000.00	707250.00	707500.00	707750.00	708000.00	708250.00
3653000.00	264.87	273.71	270.45	269.81	279.50	275.33	268.59	276.76	294.99
3652750.00	264.75	269.75	260.15	271.18	265.57	277.22	269.11	275.33	275.57
3652500.00	261.73	256.95	270.57	268.74	262.74	263.65	263.56	276.15	264.17
3652250.00	259.75	258.07	268.13	255.06	260.30	261.00	266.58	269.96	265.05
3652000.00	257.59	251.46	254.90	253.84	259.78	262.25	262.80	265.69	267.64
3651750.00	261.43	250.85	250.94	251.76	262.74	260.82	260.09	262.13	255.94
3651500.00	258.38	248.81	247.50	251.09	256.73	257.89	253.78	250.94	252.07
3651250.00	253.04	244.75	247.38	250.97	252.47	251.16	248.29	249.42	250.91
3651000.00	250.24	245.06	240.18	250.55	243.84	246.89	246.80	247.50	247.89
3650750.00	242.13	238.66	242.53	247.71	241.40	248.05	248.93	247.59	243.96
3650500.00	238.38	237.96	238.90	238.81	238.26	242.56	241.07	241.80	242.86
3650250.00	237.35	237.44	238.66	238.75	238.96	241.19	241.61	242.01	241.92
3650000.00	235.31	235.31	236.71	236.68	237.74	240.18	240.97	241.71	240.44
3649750.00	235.88	236.22	235.03	233.08	234.39	237.56	239.39	241.01	239.30
3649500.00	233.48	226.16	230.64	231.43	235.61	233.78	235.52	236.83	239.88
3649250.00	228.84	228.81	230.31	231.59	235.70	233.23	234.76	236.01	238.17
3649000.00	227.50	227.38	228.97	230.18	227.08	231.53	232.81	233.78	235.31
3648750.00	225.64	225.55	227.69	228.90	229.51	232.26	231.95	233.48	234.18
3648500.00	222.99	223.11	225.43	226.83	225.86	229.97	231.77	233.26	232.50
3648250.00	222.32	222.29	224.45	225.61	223.81	227.81	229.03	230.34	229.39
3648000.00	223.63	218.24	221.59	223.02	223.42	226.07	227.78	230.12	233.17

**MODELOPTs: CONC RURAL ELEV DFAULT

*** NETWORK ID: CART2 ; NETWORK TYPE: GRIDCART ***

* ELEVATION HEIGHTS IN METERS *

Y-COORD (METERS)	X-COORD (METERS) 708500.00	708750.00	709000.00
3653000.00	285.35	276.15	292.21
3652750.00	276.82	285.69	286.82
3652500.00	275.94	282.55	274.93
3652250.00	269.72	274.02	271.97
3652000.00	269.87	262.74	266.46
3651750.00	262.83	265.79	265.27
3651500.00	261.21	260.91	257.98
3651250.00	255.06	252.68	252.56
3651000.00	251.76	252.68	253.81
3650750.00	248.23	249.72	251.64
3650500.00	247.68	248.72	250.24
3650250.00	245.97	245.97	246.58
3650000.00	245.67	245.88	243.05
3649750.00	243.08	241.71	240.59
3649500.00	241.10	242.32	244.75
3649250.00	239.45	240.70	242.44
3649000.00	237.13	238.05	239.82
3648750.00	236.52	237.44	239.27
3648500.00	233.96	235.09	236.95
3648250.00	232.87	234.70	237.13
3648000.00	234.09	233.17	235.31

**MODELOPTs: CONC RURAL ELEV DFAULT

*** DISCRETE CARTESIAN RECEPTORS ***
(X-COORD, Y-COORD, ZELEV, ZFLAG)
(METERS)

(705006.0,	3649827.0,	228.2,	.0);	(705031.0,	3649872.0,	229.6,	.0);
(705055.0,	3649915.0,	231.0,	.0);	(705080.0,	3649960.0,	232.0,	.0);
(705096.0,	3650006.0,	232.2,	.0);	(705116.0,	3650031.0,	232.2,	.0);
(705123.0,	3650081.0,	232.8,	.0);	(705137.0,	3650129.0,	232.3,	.0);
(705152.0,	3650178.0,	235.0,	.0);	(705166.0,	3650226.0,	232.8,	.0);
(705192.0,	3650281.0,	233.5,	.0);	(705214.0,	3650326.0,	234.3,	.0);
(705235.0,	3650358.0,	236.7,	.0);	(705276.0,	3650407.0,	238.8,	.0);
(705324.0,	3650427.0,	239.4,	.0);	(705371.0,	3650450.0,	239.9,	.0);
(705436.0,	3650479.0,	242.6,	.0);	(705471.0,	3650519.0,	242.9,	.0);
(705511.0,	3650564.0,	242.9,	.0);	(705516.0,	3650614.0,	241.5,	.0);
(705511.0,	3650665.0,	240.1,	.0);	(705505.0,	3650698.0,	238.9,	.0);
(705488.0,	3650739.0,	237.5,	.0);	(705473.0,	3650788.0,	236.7,	.0);
(705472.0,	3650844.0,	234.9,	.0);	(705483.0,	3650898.0,	235.3,	.0);
(705494.0,	3650948.0,	236.9,	.0);	(705505.0,	3650998.0,	237.3,	.0);
(705518.0,	3651047.0,	237.6,	.0);	(705530.0,	3651095.0,	239.4,	.0);
(705542.0,	3651145.0,	239.7,	.0);	(705554.0,	3651191.0,	238.4,	.0);
(705569.0,	3651251.0,	238.7,	.0);	(705586.0,	3651309.0,	239.8,	.0);
(705595.0,	3651402.0,	243.2,	.0);	(705602.0,	3651434.0,	243.5,	.0);
(705625.0,	3651479.0,	243.7,	.0);	(705653.0,	3651519.0,	248.9,	.0);
(705682.0,	3651561.0,	247.7,	.0);	(705706.0,	3651599.0,	247.6,	.0);
(705735.0,	3651666.0,	248.6,	.0);	(705739.0,	3651716.0,	249.2,	.0);
(705742.0,	3651765.0,	249.3,	.0);	(705745.0,	3651816.0,	249.5,	.0);
(705748.0,	3651867.0,	249.6,	.0);	(705752.0,	3651918.0,	250.8,	.0);
(705755.0,	3651966.0,	253.7,	.0);	(705758.0,	3652015.0,	256.4,	.0);
(705807.0,	3652015.0,	252.5,	.0);	(705857.0,	3652015.0,	250.6,	.0);
(705907.0,	3652015.0,	254.0,	.0);	(705957.0,	3652015.0,	256.7,	.0);
(706007.0,	3652016.0,	254.5,	.0);	(706059.0,	3652016.0,	253.5,	.0);
(706107.0,	3652016.0,	255.1,	.0);	(706157.0,	3652016.0,	261.6,	.0);
(706207.0,	3652017.0,	261.1,	.0);	(706247.0,	3652017.0,	257.9,	.0);
(706282.0,	3651984.0,	253.5,	.0);	(706322.0,	3651951.0,	251.3,	.0);
(706357.0,	3651916.0,	251.0,	.0);	(706394.0,	3651882.0,	250.7,	.0);
(706430.0,	3651849.0,	250.1,	.0);	(706467.0,	3651815.0,	249.7,	.0);
(706504.0,	3651781.0,	251.0,	.0);	(706542.0,	3651746.0,	253.6,	.0);
(706580.0,	3651710.0,	259.1,	.0);	(706617.0,	3651677.0,	254.4,	.0);
(706668.0,	3651663.0,	256.2,	.0);	(706716.0,	3651652.0,	256.1,	.0);
(706765.0,	3651639.0,	252.4,	.0);	(706814.0,	3651627.0,	250.7,	.0);
(706863.0,	3651614.0,	248.6,	.0);	(706912.0,	3651603.0,	248.2,	.0);
(706961.0,	3651590.0,	249.8,	.0);	(707010.0,	3651578.0,	250.9,	.0);
(707057.0,	3651567.0,	250.1,	.0);	(707106.0,	3651554.0,	249.8,	.0);
(707155.0,	3651542.0,	253.0,	.0);	(707203.0,	3651529.0,	258.5,	.0);
(707256.0,	3651512.0,	256.2,	.0);	(707299.0,	3651539.0,	253.3,	.0);
(707320.0,	3651573.0,	253.9,	.0);	(707370.0,	3651574.0,	253.9,	.0);
(707421.0,	3651576.0,	259.4,	.0);	(707471.0,	3651578.0,	260.2,	.0);
(707529.0,	3651579.0,	261.2,	.0);	(707562.1,	3651552.0,	259.3,	.0);
(707574.0,	3651496.0,	256.7,	.0);	(707609.0,	3651459.0,	255.9,	.0);

**MODELOPTs: CONC RURAL ELEV DFAULT

*** DISCRETE CARTESIAN RECEPTORS ***
(X-COORD, Y-COORD, ZELEV, ZFLAG)
(METERS)

(	707663.0,	3651415.0,	253.6, .0);	(	707712.0,	3651400.0,	252.9, .0);
(	707761.0,	3651389.0,	252.0, .0);	(	707810.0,	3651377.0,	250.9, .0);
(	707857.0,	3651364.0,	249.9, .0);	(	707906.0,	3651353.0,	248.5, .0);
(	707955.0,	3651340.0,	248.7, .0);	(	708005.0,	3651329.0,	249.7, .0);
(	708053.0,	3651316.0,	249.9, .0);	(	708104.0,	3651304.0,	250.9, .0);
(	708152.0,	3651291.0,	251.3, .0);	(	708187.0,	3651283.0,	251.6, .0);
(	708187.0,	3651233.0,	250.9, .0);	(	708186.0,	3651183.0,	250.4, .0);
(	708186.0,	3651133.0,	249.9, .0);	(	708186.0,	3651083.0,	249.3, .0);
(	708186.0,	3651033.0,	248.6, .0);	(	708186.0,	3650983.0,	248.2, .0);
(	708186.0,	3650933.0,	247.8, .0);	(	708186.0,	3650883.0,	247.6, .0);
(	708186.0,	3650833.0,	247.7, .0);	(	708186.0,	3650783.0,	246.7, .0);
(	708186.0,	3650733.0,	244.4, .0);	(	708186.0,	3650683.0,	243.2, .0);
(	708186.0,	3650633.0,	243.7, .0);	(	708186.0,	3650583.0,	244.5, .0);
(	708186.0,	3650533.0,	244.5, .0);	(	708186.0,	3650483.0,	244.3, .0);
(	708186.0,	3650433.0,	244.4, .0);	(	708186.0,	3650383.0,	243.6, .0);
(	708186.0,	3650333.0,	244.7, .0);	(	708186.0,	3650283.0,	245.4, .0);
(	708186.0,	3650233.0,	245.8, .0);	(	708186.0,	3650183.0,	245.3, .0);
(	708186.0,	3650131.0,	244.0, .0);	(	708135.0,	3650102.0,	241.0, .0);
(	708091.0,	3650076.0,	239.5, .0);	(	708046.0,	3650050.0,	241.1, .0);
(	708003.0,	3650026.0,	241.8, .0);	(	707960.0,	3650001.0,	241.7, .0);
(	707915.0,	3649976.0,	241.5, .0);	(	707872.0,	3649950.0,	241.3, .0);
(	707830.0,	3649927.0,	241.1, .0);	(	707787.0,	3649902.0,	240.6, .0);
(	707744.0,	3649877.0,	239.8, .0);	(	707701.0,	3649852.0,	238.9, .0);
(	707657.0,	3649827.0,	238.4, .0);	(	707613.0,	3649802.0,	238.4, .0);
(	707570.0,	3649777.0,	238.1, .0);	(	707525.0,	3649752.0,	237.7, .0);
(	707481.0,	3649726.0,	237.1, .0);	(	707425.0,	3649695.0,	234.4, .0);
(	707400.0,	3649644.0,	234.1, .0);	(	707372.0,	3649585.0,	233.2, .0);
(	707349.0,	3649536.0,	233.1, .0);	(	707327.0,	3649490.0,	236.2, .0);
(	707305.0,	3649445.0,	232.2, .0);	(	707282.0,	3649398.0,	232.6, .0);
(	707259.0,	3649351.0,	233.0, .0);	(	707235.0,	3649303.0,	236.2, .0);
(	707212.0,	3649255.0,	233.8, .0);	(	707173.0,	3649227.0,	229.8, .0);
(	707133.0,	3649200.0,	231.6, .0);	(	707094.0,	3649171.0,	232.0, .0);
(	707051.0,	3649141.0,	228.0, .0);	(	707001.0,	3649141.0,	231.2, .0);
(	706951.0,	3649141.0,	231.0, .0);	(	706901.0,	3649141.0,	230.3, .0);
(	706871.0,	3649141.0,	229.8, .0);	(	706861.0,	3649093.0,	228.9, .0);
(	706857.0,	3649043.0,	228.9, .0);	(	706851.0,	3649000.0,	228.9, .0);
(	706833.0,	3648963.0,	228.9, .0);	(	706792.0,	3648936.0,	228.7, .0);
(	706749.0,	3648908.0,	228.5, .0);	(	706706.0,	3648881.0,	227.2, .0);
(	706662.0,	3648854.0,	226.9, .0);	(	706617.0,	3648825.0,	227.0, .0);
(	706567.0,	3648825.0,	226.4, .0);	(	706517.0,	3648825.0,	226.3, .0);
(	706467.0,	3648825.0,	226.5, .0);	(	706417.0,	3648825.0,	226.3, .0);
(	706367.0,	3648825.0,	226.2, .0);	(	706321.0,	3648825.0,	226.5, .0);
(	706283.7,	3648839.0,	226.7, .0);	(	706258.0,	3648852.0,	226.5, .0);
(	706213.0,	3648877.0,	226.3, .0);	(	706169.0,	3648901.0,	226.2, .0);
(	706122.0,	3648928.0,	226.6, .0);	(	706075.0,	3648957.0,	226.7, .0);

**MODELOPTs: CONC RURAL ELEV DFAULT

*** DISCRETE CARTESIAN RECEPTORS ***
(X-COORD, Y-COORD, ZELEV, ZFLAG)
(METERS)

(	706031.0,	3648881.0,	226.6, .0);	(	705984.0,	3649007.0,	226.7, .0);
(	705940.0,	3649031.0,	226.6, .0);	(	705892.1,	3649055.0,	225.6, .0);
(	705853.0,	3649079.0,	225.6, .0);	(	705809.0,	3649105.0,	225.8, .0);
(	705766.0,	3649128.0,	225.7, .0);	(	705723.0,	3649154.0,	225.6, .0);
(	705679.0,	3649177.0,	224.9, .0);	(	705636.0,	3649202.0,	224.4, .0);
(	705594.0,	3649225.0,	224.3, .0);	(	705558.0,	3649245.0,	224.4, .0);
(	705576.0,	3649291.0,	226.0, .0);	(	705596.0,	3649338.0,	226.2, .0);
(	705615.0,	3649385.0,	226.6, .0);	(	705634.0,	3649432.0,	227.4, .0);
(	705651.0,	3649475.0,	227.8, .0);	(	705609.0,	3649499.0,	227.4, .0);
(	705564.0,	3649523.0,	226.7, .0);	(	705519.0,	3649547.0,	226.6, .0);
(	705476.0,	3649571.0,	226.9, .0);	(	705431.0,	3649596.0,	226.7, .0);
(	705383.0,	3649622.0,	226.0, .0);	(	705341.0,	3649645.0,	225.9, .0);
(	705296.0,	3649669.0,	225.9, .0);	(	705253.0,	3649693.0,	225.8, .0);
(	705207.0,	3649717.0,	225.8, .0);	(	705161.0,	3649741.0,	225.4, .0);
(	705117.0,	3649766.0,	225.7, .0);	(	705076.0,	3649789.0,	227.4, .0);
(	705033.0,	3649812.0,	228.6, .0);	(	705586.0,	3651364.0,	243.5, .0);

**MODELOPTs: CONC RURAL ELEV DFAULT

* SOURCE-RECEPTOR COMBINATIONS FOR WHICH CALCULATIONS MAY NOT BE PERFORMED *
LESS THAN 1.0 METER OR 3*ZLB IN DISTANCE, OR WITHIN OPEN PIT SOURCE

SOURCE ID	- - RECEPTOR LOCATION - - XR (METERS)	YR (METERS)	DISTANCE (METERS)
WESTPIT	706000.0	3651250.0	OPENPIT
WESTPIT	706250.0	3651250.0	OPENPIT
WESTPIT	706000.0	3651500.0	OPENPIT
WESTPIT	706250.0	3651500.0	OPENPIT
WESTPIT	706500.0	3651500.0	OPENPIT

**MODELOPTs: CONC RURAL ELEV DFAULT

*** METEOROLOGICAL DAYS SELECTED FOR PROCESSING ***
(1=YES; 0=NO)

1 1 1

**MODELOPTs: CONC RURAL ELEV DFAULT

*** THE FIRST 24 HOURS OF METEOROLOGICAL DATA ***

FILE: C:\TRINITY\YUMTUS89.ASC FORMAT: (4I2,2F9.4,F6.1,I2,2F7.1,f9.4,f10.1,f8.4,i4,f7.2)
SURFACE STATION NO.: 3145 UPPER AIR STATION NO.: 23160
NAME: UNKNOWN NAME: UNKNOWN
YEAR: 1989 YEAR: 1989

YEAR	MONTH	DAY	HOUR	FLOW VECTOR	SPEED (M/S)	TEMP (K)	STAB CLASS	MIXING HEIGHT (M) RURAL	MIXING HEIGHT (M) URBAN	USTAR (M/S)	M-O LENGTH (M)	Z-0 (M)	IPCODE	PRATE (mm/HR)
89	1	1	1	241.0	1.54	279.8	7	1933.0	81.0	.0849	12.9	.2630	0	.00
89	1	1	2	218.0	1.00	277.0	7	1933.0	81.0	.0550	12.9	.2630	0	.00
89	1	1	3	234.0	1.03	277.0	7	1933.0	81.0	.0566	12.9	.2630	0	.00
89	1	1	4	223.0	2.06	276.5	6	1933.0	81.0	.1132	12.9	.2630	0	.00
89	1	1	5	163.0	1.54	275.4	7	1933.0	81.0	.0849	12.9	.2630	0	.00
89	1	1	6	.0	.00	274.8	7	1933.0	81.0	.0550	12.9	.2630	0	.00
89	1	1	7	.0	.00	275.4	7	1933.0	81.0	.0550	12.9	.2630	0	.00
89	1	1	8	213.0	1.03	274.8	6	76.2	154.0	.0566	12.9	.2630	0	.00
89	1	1	9	237.0	3.09	277.6	5	385.6	450.5	.2810	62.1	.2630	0	.00
89	1	1	10	221.0	4.12	280.9	4	695.1	747.0	.4655	-294.9	.2630	0	.00
89	1	1	11	224.0	3.60	284.3	3	1004.6	1043.5	.4299	-86.5	.2630	0	.00
89	1	1	12	216.0	3.09	286.5	3	1314.1	1340.0	.3873	-45.0	.2630	0	.00
89	1	1	13	213.0	3.09	287.6	3	1623.5	1636.5	.3904	-41.1	.2630	0	.00
89	1	1	14	219.0	4.63	288.2	3	1933.0	1933.0	.5432	-116.0	.2630	0	.00
89	1	1	15	222.0	3.60	289.3	3	1933.0	1933.0	.4342	-74.6	.2630	0	.00
89	1	1	16	214.0	4.12	289.3	3	1933.0	1933.0	.4736	-174.8	.2630	0	.00
89	1	1	17	181.0	3.09	289.8	4	1933.0	1933.0	.2841	66.3	.2630	0	.00
89	1	1	18	.0	.00	288.2	5	1910.4	1831.4	.0550	12.9	.2630	0	.00
89	1	1	19	.0	.00	284.3	6	1847.5	1548.2	.0550	12.9	.2630	0	.00
89	1	1	20	.0	.00	282.0	7	1784.6	1265.0	.0550	12.9	.2630	0	.00
89	1	1	21	200.0	1.00	280.9	7	1721.7	981.7	.0550	12.9	.2630	0	.00
89	1	1	22	.0	.00	282.6	7	1658.7	698.5	.0550	12.9	.2630	0	.00
89	1	1	23	.0	.00	279.3	7	1595.8	415.2	.0550	12.9	.2630	0	.00
89	1	1	24	230.0	3.09	279.3	6	1532.9	132.0	.2815	62.7	.2630	0	.00

*** NOTES: STABILITY CLASS 1=A, 2=B, 3=C, 4=D, 5=E AND 6=F.
FLOW VECTOR IS DIRECTION TOWARD WHICH WIND IS BLOWING.

**MODELOPTs: CONC RURAL ELEV DFAULT

*** THE PERIOD (8760 HRS) AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): ANSILOLD, LIMELOAD, JAWCRUSH, PULVERIZ, DIESGENR, HEAPAREA, WASTESP1, WASTESP2, WASTESP3, WASTESP4, WASTESP5, HAULRD1 , HAULRD2 , HAULRD3 , HAULRD4 , HAULRD5 , HAULRD6 , HAULRD7 , HAULRD8 , HAULRD9 , HAULRD10, HAULRD11, HAULRD12, HAULRD13, HAULRD14, HAULRD15, DELIRD1 , DELIRD2 , DELIRD3 , DELIRD4 , ...

*** NETWORK ID: CART1 ; NETWORK TYPE: GRIDCART ***

** CONC OF PM10 IN MICROGRAMS/M**3 **

Y-COORD (METERS)	X-COORD (METERS) 699000.00	700000.00	701000.00	702000.00	703000.00	704000.00	705000.00	706000.00	707000.00
3660000.00	.09803	.15162	.19804	.20863	.20393	.19977	.17420	.19973	.15073
3659000.00	.08951	.12960	.20510	.24420	.24641	.23127	.21108	.22894	.17629
3658000.00	.08526	.11416	.17662	.26627	.28904	.27378	.26107	.26674	.20749
3657000.00	.07075	.10275	.15698	.25542	.35243	.35354	.32724	.31840	.24401
3656000.00	.06152	.08812	.12881	.23122	.38162	.44203	.41975	.39392	.29502
3655000.00	.06193	.07646	.11087	.17567	.35888	.57612	.56174	.51381	.39600
3654000.00	.04800	.06470	.09974	.14855	.27637	.60850	.84642	.73395	.53014
3653000.00	.03964	.06146	.07903	.12277	.22171	.53195	1.16302	1.24918	.70616
3652000.00	.05855	.06486	.07862	.10877	.18104	.39353	1.33620	3.42377	1.18046
3651000.00	.07684	.08931	.10685	.13324	.18686	.33132	1.31098	5.70991	2.05760
3650000.00	.08321	.10174	.12509	.17051	.26309	.48553	1.63110	25.82002	2.80545
3649000.00	.07818	.09143	.11134	.15806	.28842	.67390	1.72118	2.65173	1.40752
3648000.00	.06206	.09181	.12679	.23010	.40571	.76329	.95099	.92103	.67986
3647000.00	.08166	.12734	.17095	.29669	.46493	.57368	.51475	.49577	.43377
3646000.00	.11021	.14389	.21831	.32578	.39681	.36617	.34537	.31991	.29305
3645000.00	.12870	.16703	.24466	.29586	.30130	.24767	.25285	.23045	.21096
3644000.00	.13458	.19137	.23641	.23503	.20926	.18893	.19789	.17670	.16149
3643000.00	.15427	.19573	.18968	.19058	.14844	.15580	.16271	.14171	.12843
3642000.00	.16509	.16078	.15935	.14497	.11981	.13021	.13722	.11769	.10516

**MODELOPTs: CONC RURAL ELEV DFAULT

*** THE PERIOD (8760 HRS) AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): ANSILOLD, LIMELOAD, JAWCRUSH, PULVERIZ, DIESGENR, HEAPAREA, WASTESP1,
WASTESP2, WASTESP3, WASTESP4, WASTESP5, HAULRD1 , HAULRD2 , HAULRD3 , HAULRD4 , HAULRD5 , HAULRD6 , HAULRD7 , HAULRD8 ,
HAULRD9 , HAULRD10, HAULRD11, HAULRD12, HAULRD13, HAULRD14, HAULRD15, DELIRD1 , DELIRD2 , DELIRD3 , DELIRD4 , ...

*** NETWORK ID: CART1 ; NETWORK TYPE: GRIDCART ***

** CONC OF PM10 IN MICROGRAMS/M**3 **

Y-COORD (METERS)	X-COORD (METERS) 708000.00	709000.00	710000.00	711000.00	712000.00	713000.00	714000.00	715000.00	716000.00
3660000.00	.12149	.13196	.09253	.07092	.07032	.05437	.04520	.04945	.04830
3659000.00	.14280	.14086	.09393	.08263	.07083	.05408	.05730	.05520	.04461
3658000.00	.17602	.14376	.10108	.09151	.06774	.06773	.06404	.05125	.04572
3657000.00	.21247	.14599	.11898	.09047	.08258	.07599	.06135	.05838	.06080
3656000.00	.24950	.16228	.12707	.10514	.09346	.07849	.07362	.07427	.06421
3655000.00	.27382	.18500	.14234	.12242	.10374	.09437	.08940	.07136	.05967
3654000.00	.31608	.21658	.18217	.13253	.13287	.10444	.08312	.07322	.06821
3653000.00	.39283	.28610	.21793	.17099	.12792	.11651	.09801	.08260	.07259
3652000.00	.55488	.38565	.25623	.20125	.15253	.13257	.11848	.10392	.09202
3651000.00	.82528	.48480	.33247	.24629	.18852	.15263	.12849	.11138	.09839
3650000.00	.95683	.53432	.35850	.26220	.19639	.15387	.12852	.11109	.09707
3649000.00	.65090	.42224	.30864	.22769	.17661	.14251	.12238	.10546	.09058
3648000.00	.34244	.27588	.22875	.19680	.16299	.13548	.11530	.09560	.08150
3647000.00	.28648	.18500	.16293	.14309	.13270	.11599	.10470	.09333	.08461
3646000.00	.23343	.14883	.11579	.10805	.10074	.09722	.08902	.08078	.07376
3645000.00	.18693	.14085	.10946	.08350	.07700	.07547	.07568	.07113	.06431
3644000.00	.15642	.13387	.09641	.08300	.06616	.05872	.05869	.06031	.05885
3643000.00	.13943	.12088	.08660	.07316	.06406	.05479	.04663	.04593	.05003
3642000.00	.12355	.10019	.08624	.06723	.05863	.05234	.04649	.03806	.03699

**MODELOPTs: CONC RURAL ELEV DFAULT

*** THE PERIOD (8760 HRS) AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): ANSILOLD, LIMELOAD, JAWCRUSH, PULVERIZ, DIESGENR, HEAPAREA, WASTESP1,
WASTESP2, WASTESP3, WASTESP4, WASTESP5, HAULRD1 , HAULRD2 , HAULRD3 , HAULRD4 , HAULRD5 , HAULRD6 , HAULRD7 , HAULRD8 ,
HAULRD9 , HAULRD10, HAULRD11, HAULRD12, HAULRD13, HAULRD14, HAULRD15, DELIRD1 , DELIRD2 , DELIRD3 , DELIRD4 , ...

*** NETWORK ID: CART1 ; NETWORK TYPE: GRIDCART ***

** CONC OF PM10 IN MICROGRAMS/M**3 **

Y-COORD (METERS)	X-COORD (METERS) 717000.00
3660000.00	.03970
3659000.00	.03692
3658000.00	.04935
3657000.00	.05895
3656000.00	.05193
3655000.00	.05442
3654000.00	.06176
3653000.00	.06609
3652000.00	.08203
3651000.00	.08792
3650000.00	.08537
3649000.00	.07792
3648000.00	.07223
3647000.00	.07466
3646000.00	.06754
3645000.00	.06092
3644000.00	.05418
3643000.00	.04894
3642000.00	.04210

**MODELOPTs: CONC RURAL ELEV DFAULT

*** THE PERIOD (8760 HRS) AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): ANSILOLD, LIMELOAD, JAWCRUSH, PULVERIZ, DIESGENR, HEAPAREA, WASTESP1,
WASTESP2, WASTESP3, WASTESP4, WASTESP5, HAULRD1 , HAULRD2 , HAULRD3 , HAULRD4 , HAULRD5 , HAULRD6 , HAULRD7 , HAULRD8 ,
HAULRD9 , HAULRD10, HAULRD11, HAULRD12, HAULRD13, HAULRD14, HAULRD15, DELIRD1 , DELIRD2 , DELIRD3 , DELIRD4 , ...

*** NETWORK ID: CART2 ; NETWORK TYPE: GRIDCART ***

** CONC OF PM10 IN MICROGRAMS/M**3 **

Y-COORD (METERS)	X-COORD (METERS) 704000.00	704250.00	704500.00	704750.00	705000.00	705250.00	705500.00	705750.00	706000.00
3653000.00	.53195	.70312	.83493	.97998	1.16302	1.33612	1.40297	1.31773	1.24918
3652750.00	.49367	.65140	.85326	.99746	1.19333	1.43740	1.63336	1.57118	1.49477
3652500.00	.46169	.60885	.81775	1.04280	1.21607	1.47502	1.82408	1.97216	1.83983
3652250.00	.42634	.56809	.76966	1.03653	1.29654	1.50872	1.92832	2.45575	2.36651
3652000.00	.39353	.52419	.72726	1.01083	1.33620	1.62301	1.97369	2.62962	3.42377
3651750.00	.36682	.50584	.68649	.97388	1.38490	1.77824	2.10226	2.69960	4.60450
3651500.00	.37614	.46923	.67746	.97465	1.43391	2.02731	2.51923	2.93963	3.06861
3651250.00	.34183	.44839	.60482	.92733	1.41990	2.20005	3.17203	4.50368	3.88382
3651000.00	.33132	.41076	.54273	.77898	1.31098	2.24235	3.97355	5.38333	5.70991
3650750.00	.31541	.38604	.52446	.78631	1.34168	2.47425	4.53830	8.33335	7.97154
3650500.00	.37461	.48236	.61964	.85974	1.37516	2.65004	5.43377	14.58494	16.30526
3650250.00	.46215	.55035	.69894	.95537	1.42676	2.79033	8.81273	16.24115	19.16386
3650000.00	.48553	.60578	.78013	1.05719	1.63110	3.04885	12.55804	14.30750	25.82002
3649750.00	.50390	.63021	.81563	1.11032	1.81579	3.69257	6.74260	7.51720	8.23118
3649500.00	.50949	.65669	.90439	1.31381	2.08590	3.08601	3.95841	4.51473	5.41390
3649250.00	.58186	.77989	1.03817	1.45922	2.00920	2.42291	2.90687	3.19836	3.76959
3649000.00	.67390	.84334	1.09309	1.46172	1.72118	2.01539	2.16260	2.41208	2.65173
3648750.00	.69356	.88349	1.13190	1.33656	1.52576	1.62802	1.76111	1.86030	1.97400
3648500.00	.74927	.92015	1.07686	1.24018	1.28343	1.37743	1.43073	1.46441	1.50629
3648250.00	.77098	.89549	1.03100	1.06830	1.10031	1.14205	1.16031	1.18464	1.14943
3648000.00	.76329	.86842	.92465	.91450	.95099	.96297	.95273	.95056	.92103

**MODELOPTs: CONC RURAL ELEV DFAULT

*** THE PERIOD (8760 HRS) AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): ANSILOLD, LIMELOAD, JAWCRUSH, PULVERIZ, DIESGENR, HEAPAREA, WASTESP1,
WASTESP2, WASTESP3, WASTESP4, WASTESP5, HAULRD1 , HAULRD2 , HAULRD3 , HAULRD4 , HAULRD5 , HAULRD6 , HAULRD7 , HAULRD8 ,
HAULRD9 , HAULRD10, HAULRD11, HAULRD12, HAULRD13, HAULRD14, HAULRD15, DELIRD1 , DELIRD2 , DELIRD3 , DELIRD4 , ...

*** NETWORK ID: CART2 ; NETWORK TYPE: GRIDCART ***

** CONC OF PM10 IN MICROGRAMS/M**3 **

Y-COORD (METERS)	X-COORD (METERS) 706250.00	706500.00	706750.00	707000.00	707250.00	707500.00	707750.00	708000.00	708250.00
3653000.00	1.16720	1.03634	.85366	.70616	.62231	.51892	.44846	.39283	.34585
3652750.00	1.37143	1.17560	.94277	.77792	.67616	.55408	.47750	.42491	.39066
3652500.00	1.65790	1.34207	1.04613	.88687	.72795	.60326	.53622	.47663	.41382
3652250.00	2.03809	1.55997	1.20446	1.00808	.80767	.68925	.59051	.49276	.44686
3652000.00	2.55213	1.86665	1.43029	1.18046	.92281	.77490	.63396	.55408	.49615
3651750.00	3.36867	2.37552	1.84547	1.41195	1.06885	.84063	.73422	.64241	.55403
3651500.00	2.68955	2.17295	2.70690	1.76802	1.30321	1.06263	.86808	.74192	.66100
3651250.00	4.21996	4.01966	2.66315	1.91181	1.46285	1.13620	.94281	.79600	.65906
3651000.00	10.91035	5.53055	3.06023	2.05760	1.51804	1.24177	1.00374	.82528	.71604
3650750.00	10.85443	10.94772	4.17336	2.49292	1.78558	1.32818	1.08914	.91369	.77258
3650500.00	12.69463	29.97816	5.84049	3.07051	2.02269	1.49232	1.17649	.97478	.83035
3650250.00	17.94892	14.66385	5.70471	3.21966	2.13645	1.56542	1.22077	.99851	.83955
3650000.00	16.54543	10.51104	4.66016	2.80545	1.98155	1.49826	1.17911	.95683	.80848
3649750.00	14.17790	7.49668	4.19291	2.50383	1.75680	1.35583	1.10136	.90553	.76850
3649500.00	11.94807	12.28494	5.60954	2.43997	1.63499	1.26200	1.01631	.85792	.72552
3649250.00	4.89551	6.90421	5.45135	2.24982	1.43840	1.08210	.88622	.74682	.65824
3649000.00	2.97809	3.02271	2.11522	1.40752	1.09397	.89849	.75974	.65090	.57053
3648750.00	2.00087	1.73919	1.45091	1.02898	.83602	.70224	.61837	.56208	.50392
3648500.00	1.40331	1.25865	1.11635	.85977	.72237	.56240	.51994	.46484	.43522
3648250.00	1.07219	.98419	.90313	.76086	.62426	.52292	.42034	.40292	.36854
3648000.00	.86964	.80604	.75107	.67986	.54931	.48575	.39397	.34244	.32242

**MODELOPTs: CONC RURAL ELEV DFAULT

*** THE PERIOD (8760 HRS) AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): ANSILOLD, LIMELOAD, JAWCRUSH, PULVERIZ, DIESGENR, HEAPAREA, WASTESP1, WASTESP2, WASTESP3, WASTESP4, WASTESP5, HAULRD1 , HAULRD2 , HAULRD3 , HAULRD4 , HAULRD5 , HAULRD6 , HAULRD7 , HAULRD8 , HAULRD9 , HAULRD10, HAULRD11, HAULRD12, HAULRD13, HAULRD14, HAULRD15, DELIRD1 , DELIRD2 , DELIRD3 , DELIRD4 , ...

*** NETWORK ID: CART2 ; NETWORK TYPE: GRIDCART ***

** CONC OF PM10 IN MICROGRAMS/M**3 **

Y-COORD (METERS)	X-COORD (METERS) 708500.00	708750.00	709000.00
3653000.00	.32348	.31794	.28610
3652750.00	.36306	.31596	.27930
3652500.00	.36310	.33673	.31282
3652250.00	.41356	.36589	.33614
3652000.00	.43595	.40656	.38565
3651750.00	.50595	.45943	.40071
3651500.00	.57088	.49163	.43849
3651250.00	.57108	.50731	.45341
3651000.00	.62248	.54462	.48480
3650750.00	.66421	.58753	.52282
3650500.00	.72234	.63100	.55572
3650250.00	.71598	.62629	.55695
3650000.00	.69351	.60430	.53432
3649750.00	.66553	.58322	.51437
3649500.00	.62908	.55807	.49979
3649250.00	.57526	.51259	.46050
3649000.00	.51298	.46080	.42224
3648750.00	.45714	.42133	.38559
3648500.00	.39845	.37133	.34705
3648250.00	.35069	.32659	.30906
3648000.00	.30087	.29212	.27588

**MODELOPTs: CONC RURAL ELEV DFAULT

*** THE PERIOD (8760 HRS) AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): ANSILOLD, LIMELOAD, JAWCRUSH, PULVERIZ, DIESGENR, HEAPAREA, WASTESP1, WASTESP2, WASTESP3, WASTESP4, WASTESP5, HAULRD1 , HAULRD2 , HAULRD3 , HAULRD4 , HAULRD5 , HAULRD6 , HAULRD7 , HAULRD8 , HAULRD9 , HAULRD10, HAULRD11, HAULRD12, HAULRD13, HAULRD14, HAULRD15, DELIRD1 , DELIRD2 , DELIRD3 , DELIRD4 , ...

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF PM10 IN MICROGRAMS/M**3 **

X-COORD (M)	Y-COORD (M)	CONC	X-COORD (M)	Y-COORD (M)	CONC
705006.00	3649827.00	2.09268	705031.00	3649872.00	2.58259
705055.00	3649915.00	2.32488	705080.00	3649960.00	2.11086
705096.00	3650006.00	2.00143	705116.00	3650031.00	2.02928
705123.00	3650081.00	1.98082	705137.00	3650129.00	1.97905
705152.00	3650178.00	2.01384	705166.00	3650226.00	2.08457
705192.00	3650281.00	2.25805	705214.00	3650326.00	2.43103
705235.00	3650358.00	2.59700	705276.00	3650407.00	2.91160
705324.00	3650427.00	3.33837	705371.00	3650450.00	3.78317
705436.00	3650479.00	4.50885	705471.00	3650519.00	4.86687
705511.00	3650564.00	5.26967	705516.00	3650614.00	5.13649
705511.00	3650665.00	4.89796	705505.00	3650698.00	4.72939
705488.00	3650739.00	4.43179	705473.00	3650788.00	4.17700
705472.00	3650844.00	4.07403	705483.00	3650898.00	4.06598
705494.00	3650948.00	4.04910	705505.00	3650998.00	4.01881
705518.00	3651047.00	3.98200	705530.00	3651095.00	3.87408
705542.00	3651145.00	3.70714	705554.00	3651191.00	3.56448
705569.00	3651251.00	3.42875	705586.00	3651309.00	3.29894
705595.00	3651402.00	2.96742	705602.00	3651434.00	2.87459
705625.00	3651479.00	2.79786	705653.00	3651519.00	2.73337
705682.00	3651561.00	2.65950	705706.00	3651599.00	2.64091
705735.00	3651666.00	2.69284	705739.00	3651716.00	2.67745
705742.00	3651765.00	2.66668	705745.00	3651816.00	2.67433
705748.00	3651867.00	2.68274	705752.00	3651918.00	2.67757
705755.00	3651966.00	2.66117	705758.00	3652015.00	2.64859
705807.00	3652015.00	2.84276	705857.00	3652015.00	3.08181
705907.00	3652015.00	3.28095	705957.00	3652015.00	3.35886
706007.00	3652016.00	3.31298	706059.00	3652016.00	3.29364
706107.00	3652016.00	3.17716	706157.00	3652016.00	2.93016
706207.00	3652017.00	2.68264	706247.00	3652017.00	2.52084
706282.00	3651984.00	2.47616	706322.00	3651951.00	2.41259
706357.00	3651916.00	2.36680	706394.00	3651882.00	2.31861
706430.00	3651849.00	2.29066	706467.00	3651815.00	2.28413
706504.00	3651781.00	2.27379	706542.00	3651746.00	2.26790
706580.00	3651710.00	2.30094	706617.00	3651677.00	2.33457
706668.00	3651663.00	2.26867	706716.00	3651652.00	2.20528
706765.00	3651639.00	2.14173	706814.00	3651627.00	2.02417
706863.00	3651614.00	1.88119	706912.00	3651603.00	1.76193
706961.00	3651590.00	1.66640	707010.00	3651578.00	1.58117
707057.00	3651567.00	1.51537	707106.00	3651554.00	1.45895
707155.00	3651542.00	1.40690	707203.00	3651529.00	1.35268

**MODELOPTs: CONC RURAL ELEV DFAULT

*** THE PERIOD (8760 HRS) AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): ANSILOLD, LIMELOAD, JAWCRUSH, PULVERIZ, DIESGENR, HEAPAREA, WASTESP1,
WASTESP2, WASTESP3, WASTESP4, WASTESP5, HAULRD1 , HAULRD2 , HAULRD3 , HAULRD4 , HAULRD5 , HAULRD6 , HAULRD7 , HAULRD8 ,
HAULRD9 , HAULRD10, HAULRD11, HAULRD12, HAULRD13, HAULRD14, HAULRD15, DELIRD1 , DELIRD2 , DELIRD3 , DELIRD4 , ...

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF PM10 IN MICROGRAMS/M**3 **

X-COORD (M)	Y-COORD (M)	CONC	X-COORD (M)	Y-COORD (M)	CONC
707256.00	3651512.00	1.28266	707299.00	3651539.00	1.19665
707320.00	3651573.00	1.13517	707370.00	3651574.00	1.08655
707421.00	3651576.00	1.04910	707471.00	3651578.00	1.01552
707529.00	3651579.00	.97551	707562.10	3651552.00	.97342
707574.00	3651496.00	1.00099	707609.00	3651459.00	.99250
707663.00	3651415.00	.96293	707712.00	3651400.00	.92796
707761.00	3651389.00	.89751	707810.00	3651377.00	.87314
707857.00	3651364.00	.85418	707906.00	3651353.00	.83499
707955.00	3651340.00	.81445	708005.00	3651329.00	.79007
708053.00	3651316.00	.76448	708104.00	3651304.00	.73602
708152.00	3651291.00	.70906	708187.00	3651283.00	.69010
708187.00	3651233.00	.68914	708186.00	3651183.00	.69305
708186.00	3651133.00	.70194	708186.00	3651083.00	.71492
708186.00	3651033.00	.73078	708186.00	3650983.00	.74776
708186.00	3650933.00	.76378	708186.00	3650883.00	.77745
708186.00	3650833.00	.78851	708186.00	3650783.00	.79868
708186.00	3650733.00	.80977	708186.00	3650683.00	.82162
708186.00	3650633.00	.83447	708186.00	3650583.00	.84759
708186.00	3650533.00	.85821	708186.00	3650483.00	.86447
708186.00	3650433.00	.86906	708186.00	3650383.00	.87436
708186.00	3650333.00	.87915	708186.00	3650283.00	.87888
708186.00	3650233.00	.87878	708186.00	3650183.00	.87774
708186.00	3650131.00	.87433	708135.00	3650102.00	.90224
708091.00	3650076.00	.92525	708046.00	3650050.00	.94685
708003.00	3650026.00	.96652	707960.00	3650001.00	.98672
707915.00	3649976.00	1.01215	707872.00	3649950.00	1.03988
707830.00	3649927.00	1.07004	707787.00	3649902.00	1.10288
707744.00	3649877.00	1.14004	707701.00	3649852.00	1.17943
707657.00	3649827.00	1.21812	707613.00	3649802.00	1.25628
707570.00	3649777.00	1.29358	707525.00	3649752.00	1.32840
707481.00	3649726.00	1.36299	707425.00	3649695.00	1.41919
707400.00	3649644.00	1.43913	707372.00	3649585.00	1.47970
707349.00	3649536.00	1.49623	707327.00	3649490.00	1.49384
707305.00	3649445.00	1.49990	707282.00	3649398.00	1.52333
707259.00	3649351.00	1.54052	707235.00	3649303.00	1.53483
707212.00	3649255.00	1.51473	707173.00	3649227.00	1.55941
707133.00	3649200.00	1.62119	707094.00	3649171.00	1.67472
707051.00	3649141.00	1.71477	707001.00	3649141.00	1.84689
706951.00	3649141.00	1.97937	706901.00	3649141.00	2.13471
706871.00	3649141.00	2.26078	706861.00	3649093.00	2.02797

**MODELOPTs: CONC RURAL ELEV DFAULT

*** THE PERIOD (8760 HRS) AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): ANSILOLD, LIMELOAD, JAWCRUSH, PULVERIZ, DIESGENR, HEAPAREA, WASTESP1,
WASTESP2, WASTESP3, WASTESP4, WASTESP5, HAULRD1 , HAULRD2 , HAULRD3 , HAULRD4 , HAULRD5 , HAULRD6 , HAULRD7 , HAULRD8 ,
HAULRD9 , HAULRD10, HAULRD11, HAULRD12, HAULRD13, HAULRD14, HAULRD15, DELIRD1 , DELIRD2 , DELIRD3 , DELIRD4 , ...

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF PM10 IN MICROGRAMS/M**3 **

X-COORD (M)	Y-COORD (M)	CONC	X-COORD (M)	Y-COORD (M)	CONC
706857.00	3649043.00	1.82333	706851.00	3649000.00	1.70123
706833.00	3648963.00	1.67053	706792.00	3648936.00	1.74540
706749.00	3648908.00	1.80470	706706.00	3648881.00	1.83244
706662.00	3648854.00	1.83282	706617.00	3648825.00	1.81783
706567.00	3648825.00	1.89050	706517.00	3648825.00	1.95732
706467.00	3648825.00	2.03932	706417.00	3648825.00	2.11113
706367.00	3648825.00	2.18368	706321.00	3648825.00	2.22525
706283.70	3648839.00	2.28946	706258.00	3648852.00	2.33920
706213.00	3648877.00	2.42874	706169.00	3648901.00	2.50616
706122.00	3648928.00	2.56601	706075.00	3648957.00	2.60220
706031.00	3648981.00	2.61978	705984.00	3649007.00	2.66170
705940.00	3649031.00	2.67647	705892.10	3649055.00	2.69216
705853.00	3649079.00	2.74582	705809.00	3649105.00	2.78520
705766.00	3649128.00	2.81854	705723.00	3649154.00	2.85520
705679.00	3649177.00	2.81382	705636.00	3649202.00	2.77850
705594.00	3649225.00	2.85016	705558.00	3649245.00	2.94913
705576.00	3649291.00	3.15967	705596.00	3649338.00	3.39499
705615.00	3649385.00	3.65742	705634.00	3649432.00	3.95526
705651.00	3649475.00	4.25166	705609.00	3649499.00	4.26746
705564.00	3649523.00	4.32303	705519.00	3649547.00	4.33379
705476.00	3649571.00	4.36114	705431.00	3649596.00	4.37777
705383.00	3649622.00	4.30850	705341.00	3649645.00	4.13486
705296.00	3649669.00	3.84178	705253.00	3649693.00	3.57987
705207.00	3649717.00	3.20658	705161.00	3649741.00	2.75292
705117.00	3649766.00	2.37829	705076.00	3649789.00	2.15103
705033.00	3649812.00	2.02645	705586.00	3651364.00	3.09050

**MODELOPTs: CONC RURAL ELEV DFAULT

*** THE SUMMARY OF MAXIMUM PERIOD (8760 HRS) RESULTS ***

** CONC OF PM10 IN MICROGRAMS/M**3 **

GROUP ID	AVERAGE CONC	RECEPTOR (XR, YR, ZELEV, ZFLAG)	OF TYPE	NETWORK GRID-ID
ALL	1ST HIGHEST VALUE IS 29.97816	AT (706500.00, 3650500.00, 237.96, .00)	GC	CART2
	2ND HIGHEST VALUE IS 25.82002	AT (706000.00, 3650000.00, 234.03, .00)	GC	CART1

*** RECEPTOR TYPES: GC = GRIDCART
GP = GRIDPOLR
DC = DISCCART
DP = DISCPOLR
BD = BOUNDARY

**MODELOPTs: CONC RURAL ELEV DFAULT

*** Message Summary : ISCST3 Model Execution ***

--------- Summary of Total Messages --------

A Total of 0 Fatal Error Message(s)
A Total of 0 Warning Message(s)
A Total of 875 Informational Message(s)

A Total of 875 Calm Hours Identified

******** FATAL ERROR MESSAGES ********
*** NONE ***

******** WARNING MESSAGES ********
*** NONE ***

****
*** ISCST3 Finishes Successfully ***
****

APPENDIX L-3

Average Annual PM_{10} Concentrations
1000 and 250 Meter Screening Grid & Discrete (Boundary) Receptors

```
1                    ISCST3 - (DATED 96113)

               IBM-PC VERSION (3.00)    ISCST3R
      (C) COPYRIGHT 1992-1996, TRINITY CONSULTANTS, INC.

 Run Began on  8/09/1996 at 18:37:20


 ** BREEZE AIR ISCST3 - C:\TRINITY\0959XI38.DAT
 ** Trinity Consultants Incorporated, Dallas, TX

 CO STARTING
 CO TITLEONE  IMPERIAL PROJECT PM-10 IMPACT ASSESSMENT
 CO TITLETWO  24-HR IMPACTS - 100 METER GRID
 CO MODELOPT  DFAULT  CONC  RURAL
 CO AVERTIME  24
 CO POLLUTID  PM10
 CO TERRHGTS  ELEV
 CO RUNORNOT  RUN
 CO SAVEFILE  SAVE1.FIL  5  C:\TRINITY\0959XI38.SV2
 CO ERRORFIL  ERROR.LST
 CO FINISHED

 SO STARTING
 SO ELEVUNIT  METERS
 SO LOCATION  ANSILOLD  POINT  706591.0  3650227.0  243.84
 SO LOCATION  LIMELOAD  POINT  706572.0  3650230.0  243.84
 SO LOCATION  JAWCRUSH  POINT  705358.0  3649725.0  231.65
 SO LOCATION  PULVERIZ  POINT  705344.0  3649697.0  231.65
 SO LOCATION  DIESGENR  POINT  705549.0  3649588.0  231.65
 SO LOCATION  HEAPAREA  AREA  706070.0  3649505.0  274.32
 SO LOCATION  WASTESP1  AREA  705324.0  3649918.0  289.56
 SO LOCATION  WASTESP2  AREA  705727.0  3649955.0  289.56
 SO LOCATION  WASTESP3  AREA  705969.0  3650067.0  289.56
 SO LOCATION  WASTESP4  AREA  706081.0  3650067.0  289.56
 SO LOCATION  WASTESP5  AREA  705936.0  3650003.0  289.56
 SO LOCATION  HAULRD1  AREA  706354.0  3650693.0  249.94
 SO LOCATION  HAULRD2  AREA  706386.0  3650629.0  249.94
 SO LOCATION  HAULRD3  AREA  706530.0  3650453.0  249.94
 SO LOCATION  HAULRD4  AREA  706450.0  3650405.0  249.94
 SO LOCATION  HAULRD5  AREA  706337.0  3650260.0  259.08
 SO LOCATION  HAULRD6  AREA  706225.0  3650068.0  274.32
 SO LOCATION  HAULRD7  AREA  706065.0  3650020.0  281.94
 SO LOCATION  HAULRD8  AREA  705904.0  3649971.0  289.56
 SO LOCATION  HAULRD9  AREA  706556.0  3650468.0  243.84
 SO LOCATION  HAULRD10  AREA  706562.0  3650285.0  243.84
 SO LOCATION  HAULRD11  AREA  706482.0  3650116.0  243.84
 SO LOCATION  HAULRD12  AREA  706418.0  3649939.0  243.84
 SO LOCATION  HAULRD13  AREA  706386.0  3649923.0  243.84
 SO LOCATION  HAULRD14  AREA  706229.0  3649812.0  243.84
 SO LOCATION  HAULRD15  AREA  706128.0  3649658.0  243.84
 SO LOCATION  DELIRD1  AREA  705010.0  3649832.0  243.84
 SO LOCATION  DELIRD2  AREA  705083.0  3649923.0  243.84
 SO LOCATION  DELIRD3  AREA  705240.0  3649830.0  243.84
 SO LOCATION  DELIRD4  AREA  705407.0  3649734.0  243.84
 SO LOCATION  DELIRD5  AREA  705544.0  3649641.0  243.84
 SO LOCATION  DELIRD6  AREA  705690.0  3649761.0  243.84
 SO LOCATION  DELIRD7  AREA  705825.0  3649872.0  243.84
 SO LOCATION  DELIRD8  AREA  705987.0  3649879.0  243.84
 SO LOCATION  DELIRD9  AREA  706146.0  3649953.0  243.84
 SO LOCATION  DELIRD10  AREA  706303.0  3650027.0  243.84
 SO LOCATION  DELIRD11  AREA  706400.0  3650194.0  243.84
 SO LOCATION  DELIRD12  AREA  706464.0  3650308.0  243.84
 SO LOCATION  DELIRD13  AREA  706528.0  3650420.0  243.84
 SO LOCATION  LIMEAPPL  AREA  706555.0  3650237.0  243.84
 SO LOCATION  LIMEHOPP  AREA  706571.0  3650231.0  243.84
 SO LOCATION  ANSILOUN  AREA  706590.0  3650227.0  243.84
 SO LOCATION  WESTPIT  OPENPIT  705777.0  3651283.0  249.94
 SO SRCPARAM  ANSILOLD  1.31250000E-03  22.16  299.81  8.17  0.20
 SO SRCPARAM  LIMELOAD  3.54375000E-04  22.16  299.81  8.17  0.20
 SO SRCPARAM  JAWCRUSH  3.80181000E-04  4.57  299.81  0.01  1.83
 SO SRCPARAM  PULVERIZ  3.80181000E-04  1.52  299.81  0.01  1.83
 SO SRCPARAM  DIESGENR  0.00000000E+00  3.05  322.04  21.34  0.20
 SO SRCPARAM  HEAPAREA  8.49186000E-07  0.00  700.00  273.98  30.0  4.56
 SO SRCPARAM  WASTESP1  8.51000000E-07  0.00  333.33  916.69  30.0  4.92
 SO SRCPARAM  WASTESP2  8.51000000E-07  0.00  160.42  641.68  30.0  4.92
 SO SRCPARAM  WASTESP3  8.51000000E-07  0.00  96.25  417.09  30.0  4.92
 SO SRCPARAM  WASTESP4  8.51000000E-07  0.00  48.12  304.80  30.0  4.92
 SO SRCPARAM  WASTESP5  8.51000000E-07  0.00  64.17  64.17  30.0  4.92
 SO SRCPARAM  HAULRD1  1.07201000E-05  0.00  30.48  192.51  -15.0  5.91
 SO SRCPARAM  HAULRD2  1.07201000E-05  0.00  30.48  48.12  -30.0  5.91
 SO SRCPARAM  HAULRD3  1.07201000E-05  0.00  30.48  224.59  -40.0  5.91
 SO SRCPARAM  HAULRD4  8.44041000E-06  0.00  30.48  80.21  31.0  5.86
 SO SRCPARAM  HAULRD5  8.44041000E-06  0.00  30.48  192.51  35.0  5.86
 SO SRCPARAM  HAULRD6  8.44041000E-06  0.00  30.48  208.55  30.0  5.86
 SO SRCPARAM  HAULRD7  8.44041000E-06  0.00  30.48  144.38  75.0  5.86
 SO SRCPARAM  HAULRD8  8.44041000E-06  0.00  30.48  144.38  72.0  5.86
 SO SRCPARAM  HAULRD9  2.83416000E-06  0.00  30.48  112.29  150.0  5.38
 SO SRCPARAM  HAULRD10  2.92525000E-06  0.00  30.48  96.25  20.0  5.31
 SO SRCPARAM  HAULRD11  2.83416000E-06  0.00  30.48  208.55  20.0  5.38
 SO SRCPARAM  HAULRD12  2.83416000E-06  0.00  30.48  176.46  20.0  5.38
 SO SRCPARAM  HAULRD13  1.46821000E-06  0.00  30.48  32.08  55.0  4.71
 SO SRCPARAM  HAULRD14  2.83416000E-06  0.00  30.48  192.51  55.0  5.38
 SO SRCPARAM  HAULRD15  2.83416000E-06  0.00  30.48  192.51  30.0  5.38
 SO SRCPARAM  DELIRD1  6.45552000E-07  0.00  9.14  91.40  30.0  2.52
```



```
 SO SRCPARAM  DELIRD2  6.45552000E-07  0.00  9.14  91.40  119.0  2.52
 SO SRCPARAM  DELIRD3  6.45552000E-07  0.00  9.14  91.40  119.0  2.52
 SO SRCPARAM  DELIRD4  6.45552000E-07  0.00  9.14  91.40  119.0  2.52
 SO SRCPARAM  DELIRD5  6.45552000E-07  0.00  9.14  91.40  50.0  2.52
 SO SRCPARAM  DELIRD6  6.45552000E-07  0.00  9.14  91.40  50.0  2.52
 SO SRCPARAM  DELIRD7  6.45552000E-07  0.00  9.14  91.40  88.0  2.52
 SO SRCPARAM  DELIRD8  6.45552000E-07  0.00  9.14  91.40  64.0  2.52
 SO SRCPARAM  DELIRD9  6.45552000E-07  0.00  9.14  91.40  64.0  2.52
 SO SRCPARAM  DELIRD10  6.45552000E-07  0.00  9.14  91.40  30.0  2.52
 SO SRCPARAM  DELIRD11  6.45552000E-07  0.00  9.14  91.40  30.0  2.52
 SO SRCPARAM  DELIRD12  6.45552000E-07  0.00  9.14  91.40  29.0  2.52
 SO SRCPARAM  DELIRD13  6.45552000E-07  0.00  9.14  64.17  110.0  2.52
 SO SRCPARAM  LIMEAPPL  4.12819000E-05  0.00  1.52  3.05  30.0  6.10
 SO SRCPARAM  LIMEHOPP  4.08131600E-03  0.00  0.91  0.91  30.0  6.10
 SO SRCPARAM  ANSILOUN  9.33554000E-04  0.00  0.91  0.91  0.0  3.05
 SO SRCPARAM  WESTPIT  1.73397000E-06  6.00  581.86  581.86  62100000.0  30.0
 SO PARTDIAM  WESTPIT  10
 SO MASSFRAX  WESTPIT  1
 SO PARTDENS  WESTPIT  2.5
 SO CONCUNIT  1.00E+06  GRAMS/SEC  MICROGRAMS/M**3
 SO SRCGROUP  ALL
 SO FINISHED

 RE STARTING
 RE ELEVUNIT  FEET
 RE GRIDCART CART1 STA
 RE GRIDCART CART1 XYINC  705000  11  100  3649000  21  100
 RE GRIDCART CART1 ELEV  1  729.3  729.0  729.0  732.3  733.0  733.2  733.0
 RE GRIDCART CART1 ELEV  1  736.2  738.6  739.0  744.0
 RE GRIDCART CART1 ELEV  2  731.0  730.0  730.0  733.7  734.0  734.0  734.0
 RE GRIDCART CART1 ELEV  2  737.2  740.2  740.0  745.1
 RE GRIDCART CART1 ELEV  3  732.0  732.0  732.0  735.6  736.0  736.0  736.0
 RE GRIDCART CART1 ELEV  3  739.3  742.7  743.0  747.0
 RE GRIDCART CART1 ELEV  4  739.3  738.8  738.0  741.3  742.2  741.6  741.3
 RE GRIDCART CART1 ELEV  4  744.8  748.4  748.3  751.6
 RE GRIDCART CART1 ELEV  5  742.3  741.2  740.8  745.0  744.8  744.2  744.7
 RE GRIDCART CART1 ELEV  5  747.8  752.0  752.7  755.8
 RE GRIDCART CART1 ELEV  6  738.0  738.0  737.7  742.0  744.0  744.0  745.0
 RE GRIDCART CART1 ELEV  6  749.3  754.3  756.0  755.0
 RE GRIDCART CART1 ELEV  7  745.0  739.2  736.4  739.7  743.0  744.6  747.0
 RE GRIDCART CART1 ELEV  7  753.6  755.9  768.0  753.3
 RE GRIDCART CART1 ELEV  8  741.0  738.9  739.0  745.0  747.6  748.2  750.7
 RE GRIDCART CART1 ELEV  8  756.6  768.6  771.7  761.5
 RE GRIDCART CART1 ELEV  9  755.0  748.3  742.3  741.0  743.7  746.7  751.0
 RE GRIDCART CART1 ELEV  9  760.0  761.7  782.0  775.6
 RE GRIDCART CART1 ELEV  10  767.7  749.9  746.0  755.7  759.0  755.2  756.3
 RE GRIDCART CART1 ELEV  10  761.8  764.8  769.3  767.6
 RE GRIDCART CART1 ELEV  11  784.7  760.4  753.8  773.0  769.0  758.0  757.0
 RE GRIDCART CART1 ELEV  11  751.6  766.2  769.7  767.8
 RE GRIDCART CART1 ELEV  12  806.0  771.7  758.7  772.0  765.0  757.3  759.0
 RE GRIDCART CART1 ELEV  12  758.0  769.0  772.0  770.0
 RE GRIDCART CART1 ELEV  13  794.0  776.4  773.4  775.7  776.6  776.0  773.7
 RE GRIDCART CART1 ELEV  13  772.8  779.6  780.0  777.1
 RE GRIDCART CART1 ELEV  14  777.0  768.8  766.8  768.3  773.9  776.8  775.0
 RE GRIDCART CART1 ELEV  14  774.0  779.6  780.3  778.3
 RE GRIDCART CART1 ELEV  15  781.0  781.0  780.7  784.0  791.3  799.7  794.0
 RE GRIDCART CART1 ELEV  15  790.7  792.3  790.0  786.0
 RE GRIDCART CART1 ELEV  16  775.7  781.8  781.6  784.0  788.9  799.4  802.7
 RE GRIDCART CART1 ELEV  16  795.8  790.2  784.3  785.5
 RE GRIDCART CART1 ELEV  17  772.7  784.8  784.0  785.0  786.5  792.6  801.3
 RE GRIDCART CART1 ELEV  17  806.5  802.2  797.7  792.8
 RE GRIDCART CART1 ELEV  18  769.0  780.0  780.0  782.0  781.7  783.0  795.0
 RE GRIDCART CART1 ELEV  18  804.0  808.0  802.0  795.9
 RE GRIDCART CART1 ELEV  19  780.0  783.3  781.7  780.3  778.6  774.5  790.3
 RE GRIDCART CART1 ELEV  19  784.6  808.3  808.3  802.2
 RE GRIDCART CART1 ELEV  20  807.7  795.0  788.0  781.3  774.9  773.0  786.7
 RE GRIDCART CART1 ELEV  20  803.2  799.4  816.3  815.8
 RE GRIDCART CART1 ELEV  21  860.0  825.0  793.3  780.0  780.7  778.3  781.0
 RE GRIDCART CART1 ELEV  21  806.3  808.3  809.0  821.7
 RE GRIDCART CART1 END
 RE FINISHED

 ME STARTING
 ME INPUTFIL  C:\TRINITY\YUMTUS89.ASC
 ME ANEMHGHT  10.0  METERS
 ME SURFDATA  3145  1989
 ME UAIRDATA  23160  1989
 ME STARTEND  89  01  01  1  89  12  31  24
 ME FINISHED

 OU STARTING
 OU RECTABLE  24  FIRST
 OU FINISHED


  *** Message Summary For ISC3 Model Setup ***

  --------- Summary of Total Messages --------

 A Total of           0 Fatal Error Message(s)
 A Total of           1 Warning Message(s)
 A Total of           0 Informational Message(s)

    ******** FATAL ERROR MESSAGES ********
```

```
            *** NONE ***

   ********   WARNING MESSAGES   ********
SO W320    65 PPARM :Source Parameter May Be Out-of-Range for Parameter      QS

**********************************
*** SETUP Finishes Successfully ***
**********************************
```



```
 *** ISCST3 - VERSION 96113 ***    ***  IMPERIAL PROJECT PM-10 IMPACT ASSESSMENT                    ***        08/09/96
                                  ***  24-HR IMPACTS - 100 METER GRID                              ***        18:17:21
                                                                                                             PAGE    1

**MODELOPTs: CONC                        RURAL  ELEV          DFAULT

                                           ***     MODEL SETUP OPTIONS SUMMARY       ***
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -

**Intermediate Terrain Processing is Selected

**Model Is Setup For Calculation of Average CONCentration Values.

  --  SCAVENGING/DEPOSITION LOGIC --
**Model Uses NO DRY DEPLETION.  DDPLETE = F
**Model Uses NO WET DEPLETION.  WDPLETE = F
**NO WET SCAVENGING Data Provided.
**Model Does NOT Use GRIDDED TERRAIN Data for Depletion Calculations

**Model Uses RURAL Dispersion.

**Model Uses Regulatory DEFAULT Options:
          1. Final Plume Rise.
          2. Stack-tip Downwash.
          3. Buoyancy-induced Dispersion.
          4. Use Calms Processing Routine.
          5. Not Use Missing Data Processing Routine.
          6. Default Wind Profile Exponents.
          7. Default Vertical Potential Temperature Gradients.
          8. "Upper Bound" Values for Supersquat Buildings.
          9. No Exponential Decay for RURAL Mode

**Model Accepts Receptors on ELEV Terrain.

**Model Assumes No FLAGPOLE Receptor Heights.

**Model Calculates  1 Short Term Average(s) of:  24-HR

**This Run Includes:    43 Source(s);       1 Source Group(s); and    231 Receptor(s)

**The Model Assumes A Pollutant Type of:  PM10

**Model Set To Continue RUNning After the Setup Testing.

**Output Options Selected:
        Model Outputs Tables of Highest Short Term Values by Receptor (RECTABLE Keyword)

**NOTE:  The Following Flags May Appear Following CONC Values:  c for Calm Hours
                                                                m for Missing Hours
                                                                b for Both Calm and Missing Hours

**Misc. Inputs:  Anem. Hgt. (m) =    10.00 ;    Decay Coef. =    .0000     ;    Rot. Angle =     .0
                 Emission Units = GRAMS/SEC                                ;  Emission Rate Unit Factor =    .10000E+07
                 Output Units   = MICROGRAMS/M**3

**Input Runstream File: C:\TRINITY\0959XI38.DAT                ;  **Output Print File: C:\TRINITY\0959XI38.LST
**File for Saving Result Arrays: SAVE1.FIL
**Detailed Error/Message File:   ERROR.LST
```

**MODELOPTs: CONC RURAL ELEV DFAULT

*** POINT SOURCE DATA ***

SOURCE ID	NUMBER PART. CATS.	EMISSION RATE (GRAMS/SEC)	X (METERS)	Y (METERS)	BASE ELEV. (METERS)	STACK HEIGHT (METERS)	STACK TEMP. (DEG.K)	STACK EXIT VEL. (M/SEC)	STACK DIAMETER (METERS)	BUILDING EXISTS	EMISSION RATE SCALAR VARY BY
ANSILOLD	0	.13125E-02	706591.0	3650227.0	243.8	22.16	299.81	8.17	.20	NO	
LIMELOAD	0	.35437E-03	706572.0	3650230.0	243.8	22.16	299.81	8.17	.20	NO	
JAWCRUSH	0	.38018E-03	705358.0	3649725.0	231.7	4.57	299.81	.01	1.83	NO	
PULVERIZ	0	.38018E-03	705344.0	3649697.0	231.7	1.52	299.81	.01	1.83	NO	
DIESGENR	0	.00000E+00	705549.0	3649588.0	231.7	3.05	322.04	21.34	.20	NO	

**MODELOPTs: CONC RURAL ELEV DFAULT

*** AREA SOURCE DATA ***

SOURCE ID	NUMBER PART. CATS.	EMISSION RATE (GRAMS/SEC /METER**2)	COORD (SW CORNER) X (METERS)	Y (METERS)	BASE ELEV. (METERS)	RELEASE HEIGHT (METERS)	X-DIM OF AREA (METERS)	Y-DIM OF AREA (METERS)	ORIENT. OF AREA (DEG.)	INIT. SZ (METERS)	EMISSION RATE SCALAR VARY BY
HEAPAREA	0	.84919E-06	706070.0	3649505.0	274.3	.00	700.00	273.98	30.00	4.56	
WASTESP1	0	.85100E-06	705324.0	3649918.0	289.6	.00	333.33	916.69	30.00	4.92	
WASTESP2	0	.85100E-06	705727.0	3649955.0	289.6	.00	160.42	641.68	30.00	4.92	
WASTESP3	0	.85100E-06	705969.0	3650067.0	289.6	.00	96.25	417.09	30.00	4.92	
WASTESP4	0	.85100E-06	706081.0	3650067.0	289.6	.00	48.12	304.80	30.00	4.92	
WASTESP5	0	.85100E-06	705936.0	3650003.0	289.6	.00	64.17	64.17	30.00	4.92	
HAULRD1	0	.10720E-04	706354.0	3650693.0	249.9	.00	30.48	192.51	-15.00	5.91	
HAULRD2	0	.10720E-04	706386.0	3650629.0	249.9	.00	30.48	48.12	-30.00	5.91	
HAULRD3	0	.10720E-04	706530.0	3650451.0	249.9	.00	30.48	224.59	-40.00	5.91	
HAULRD4	0	.84404E-05	706450.0	3650405.0	249.9	.00	30.48	80.21	31.00	5.86	
HAULRD5	0	.84404E-05	706137.0	3650260.0	259.1	.00	30.48	192.51	35.00	5.86	
HAULRD6	0	.84404E-05	706225.0	3650068.0	274.3	.00	30.48	208.55	30.00	5.86	
HAULRD7	0	.84404E-05	706065.0	3650020.0	281.9	.00	30.48	144.38	75.00	5.86	
HAULRD8	0	.84404E-05	705904.0	3649971.0	289.6	.00	30.48	144.38	72.00	5.86	
HAULRD9	0	.28342E-05	706556.0	3650468.0	243.8	.00	30.48	112.29	150.00	5.38	
HAULRD10	0	.29253E-05	706562.0	3650285.0	243.8	.00	30.48	96.25	20.00	5.31	
HAULRD11	0	.28342E-05	706482.0	3650116.0	243.8	.00	30.48	208.55	20.00	5.38	
HAULRD12	0	.28342E-05	706418.0	3649939.0	243.8	.00	30.48	176.46	20.00	5.38	
HAULRD13	0	.14682E-05	706386.0	3649923.0	243.8	.00	30.48	32.08	55.00	4.71	
HAULRD14	0	.28342E-05	706229.0	3649812.0	243.8	.00	30.48	192.51	55.00	5.38	
HAULRD15	0	.28342E-05	706128.0	3649658.0	243.8	.00	30.48	192.51	30.00	5.38	
DELIRD1	0	.64555E-06	705010.0	3649832.0	243.8	.00	9.14	91.40	30.00	2.52	
DELIRD2	0	.64555E-06	705083.0	3649923.0	243.8	.00	9.14	91.40	119.00	2.52	
DELIRD3	0	.64555E-06	705240.0	3649830.0	243.8	.00	9.14	91.40	119.00	2.52	
DELIRD4	0	.64555E-06	705407.0	3649734.0	243.8	.00	9.14	91.40	119.00	2.52	
DELIRD5	0	.64555E-06	705544.0	3649641.0	243.8	.00	9.14	91.40	50.00	2.52	
DELIRD6	0	.64555E-06	705690.0	3649761.0	243.8	.00	9.14	91.40	50.00	2.52	
DELIRD7	0	.64555E-06	705825.0	3649872.0	243.8	.00	9.14	91.40	88.00	2.52	
DELIRD8	0	.64555E-06	705987.0	3649879.0	243.8	.00	9.14	91.40	64.00	2.52	
DELIRD9	0	.64555E-06	706146.0	3649953.0	243.8	.00	9.14	91.40	64.00	2.52	
DELIRD10	0	.64555E-06	706303.0	3650027.0	243.8	.00	9.14	91.40	30.00	2.52	
DELIRD11	0	.64555E-06	706400.0	3650194.0	243.8	.00	9.14	91.40	30.00	2.52	
DELIRD12	0	.64555E-06	706464.0	3650308.0	243.8	.00	9.14	91.40	29.00	2.52	
DELIRD13	0	.64555E-06	706528.0	3650420.0	243.8	.00	9.14	64.17	110.00	2.52	
LIMEAPPL	0	.41282E-04	706555.0	3650237.0	243.8	.00	1.52	3.05	30.00	6.10	
LIMEHOPP	0	.40811E-02	706571.0	3650231.0	243.8	.00	.91	.91	30.00	6.10	
ANSILOUN	0	.93355E-03	706590.0	3650227.0	243.8	.00	.91	.91	.00	3.05	

**MODELOPTs: CONC RURAL ELEV DFAULT

*** OPENPIT SOURCE DATA ***

SOURCE ID	NUMBER PART. CATS.	EMISSION RATE (GRAMS/SEC /METER**2)	COORD (SW CORNER) X (METERS)	Y (METERS)	BASE ELEV. (METERS)	RELEASE HEIGHT (METERS)	X-DIM OF PIT (METERS)	Y-DIM OF PIT (METERS)	ORIENT. OF PIT (DEG.)	VOLUME OF PIT (M**3)	EMISSION RATE SCALAR VARY BY
WESTPIT	1	.17340E-05	705777.0	3651283.0	249.9	6.00	581.86	581.86	30.00	.62100E+08	

**MODELOPTs: CONC RURAL ELEV DFAULT

*** SOURCE IDs DEFINING SOURCE GROUPS ***

GROUP ID	SOURCE IDs
ALL	ANSILOLD, LIMELOAD, JAWCRUSH, PULVERIZ, DIESGENR, HEAPAREA, WASTESP1, WASTESP2, WASTESP3, WASTESP4, WASTESP5, HAULRD1 , HAULRD2 , HAULRD3 , HAULRD4 , HAULRD5 , HAULRD6 , HAULRD7 , HAULRD8 , HAULRD9 , HAULRD10, HAULRD11, HAULRD12, HAULRD13, HAULRD14, HAULRD15, DELIRD1 , DELIRD2 , DELIRD3 , DELIRD4 , DELIRD5 , DELIRD6 , DELIRD7 , DELIRD8 , DELIRD9 , DELIRD10, DELIRD11, DELIRD12, DELIRD13, LIMEAPPL, LIMEHOPP, ANSILOUN, WESTPIT ,

**MODELOPTs: CONC RURAL ELEV DFAULT

*** SOURCE PARTICULATE/GAS DATA ***

*** SOURCE ID = WESTPIT ; SOURCE TYPE = OPENPIT ***

MASS FRACTION =
1.00000,

PARTICLE DIAMETER (MICRONS) =
10.00000,

PARTICLE DENSITY (G/CM**3) =
2.50000,

**MODELOPTs: CONC RURAL ELEV DFAULT

*** GRIDDED RECEPTOR NETWORK SUMMARY ***

*** NETWORK ID: CART1 ; NETWORK TYPE: GRIDCART ***

*** X-COORDINATES OF GRID ***
(METERS)

705000.0, 705100.0, 705200.0, 705300.0, 705400.0, 705500.0, 705600.0, 705700.0, 705800.0, 705900.0,
706000.0,

*** Y-COORDINATES OF GRID ***
(METERS)

3649000.0, 3649100.0, 3649200.0, 3649300.0, 3649400.0, 3649500.0, 3649600.0, 3649700.0, 3649800.0, 3649900.0,
3650000.0, 3650100.0, 3650200.0, 3650300.0, 3650400.0, 3650500.0, 3650600.0, 3650700.0, 3650800.0, 3650900.0,
3651000.0,

**MODELOPTs: CONC RURAL ELEV DFAULT

*** NETWORK ID: CART1 ; NETWORK TYPE: GRIDCART ***

* ELEVATION HEIGHTS IN METERS *

Y-COORD (METERS)	X-COORD (METERS) 705000.00	705100.00	705200.00	705300.00	705400.00	705500.00	705600.00	705700.00	705800.00
3651000.00	262.13	251.46	241.80	237.74	237.96	237.23	238.05	245.76	246.37
3650900.00	246.19	242.32	240.18	238.14	236.19	235.61	239.79	244.82	243.66
3650800.00	237.74	238.75	238.26	237.84	237.32	236.07	240.88	239.15	246.37
3650700.00	234.39	237.74	237.74	238.35	238.26	238.66	242.32	245.06	246.28
3650600.00	235.52	239.21	238.96	239.27	239.73	241.58	244.24	245.82	244.51
3650500.00	236.43	238.29	238.23	238.96	240.46	243.66	244.66	242.56	240.85
3650400.00	238.05	238.05	237.96	238.96	241.19	243.75	242.01	241.01	241.49
3650300.00	236.83	234.33	233.72	234.18	235.88	236.77	236.22	235.92	237.62
3650200.00	242.01	236.65	235.73	236.43	236.71	236.52	235.82	235.55	237.62
3650100.00	245.67	235.21	231.25	235.31	233.17	230.83	231.34	231.04	234.39
3650000.00	239.18	231.77	229.76	235.61	234.39	231.04	230.73	229.09	233.54
3649900.00	233.99	228.57	227.38	230.14	231.34	230.18	230.52	232.20	233.11
3649800.00	230.12	228.08	226.25	225.86	226.68	227.59	228.90	231.65	232.17
3649700.00	225.86	225.22	225.25	227.08	227.87	228.05	228.81	230.61	234.27
3649600.00	227.08	225.31	224.45	225.46	226.47	226.95	227.69	229.70	230.40
3649500.00	224.94	224.94	224.85	226.16	226.77	226.77	227.08	228.39	229.91
3649400.00	226.25	225.92	225.80	227.08	227.02	226.83	226.98	227.93	229.21
3649300.00	225.34	225.19	224.94	225.95	226.22	226.04	225.95	227.02	228.11
3649200.00	223.11	223.11	223.11	224.03	224.33	224.33	224.33	225.34	226.37
3649100.00	222.81	222.50	222.50	223.63	223.72	223.72	223.72	224.70	225.61
3649000.00	222.29	222.20	222.20	223.21	223.42	223.48	223.42	224.39	225.13

**MODELOPTs: CONC RURAL ELEV DFAULT

*** NETWORK ID: CART1 ; NETWORK TYPE: GRIDCART ***

* ELEVATION HEIGHTS IN METERS *

Y-COORD (METERS)	X-COORD (METERS) 705900.00	706000.00
3651000.00	246.58	250.45
3650900.00	248.81	248.66
3650800.00	246.37	244.51
3650700.00	244.45	242.59
3650600.00	243.14	241.65
3650500.00	239.05	239.42
3650400.00	240.79	239.57
3650300.00	237.84	237.23
3650200.00	237.74	236.86
3650100.00	235.31	234.70
3650000.00	234.60	234.03
3649900.00	234.48	233.96
3649800.00	238.35	236.40
3649700.00	235.21	232.11
3649600.00	234.09	229.61
3649500.00	230.43	230.12
3649400.00	229.42	230.37
3649300.00	228.08	229.09
3649200.00	226.47	227.69
3649100.00	225.55	227.11
3649000.00	225.25	226.77

**MODELOPTs: CONC RURAL ELEV DFAULT

*** METEOROLOGICAL DAYS SELECTED FOR PROCESSING ***
(1=YES; 0=NO)

1 1 1

**MODELOPTs: CONC RURAL ELEV DFAULT

*** THE 1ST HIGHEST 24-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): ANSILOLD, LIMELOAD, JAWCRUSH, PULVERIZ, DIESGENR, HEAPAREA, WASTESP1,
WASTESP2, WASTESP3, WASTESP4, WASTESP5, HAULRD1 , HAULRD2 , HAULRD3 , HAULRD4 , HAULRD5 , HAULRD6 , HAULRD7 , HAULRD8 ,
HAULRD9 , HAULRD10, HAULRD11, HAULRD12, HAULRD13, HAULRD14, HAULRD15, DELIRD1 , DELIRD2 , DELIRD3 , DELIRD4 , . . . ,

*** NETWORK ID: CART1 ; NETWORK TYPE: GRIDCART ***

** CONC OF PM10 IN MICROGRAMS/M**3 **

Y-COORD (METERS)	X-COORD (METERS) 705000.00	705100.00	705200.00	705300.00	705400.00
3651000.0	8.69598c(89090324)	9.86799c(89090324)	9.95842c(89090324)	9.87734c(89090324)	11.23091c(89041624)
3650900.0	8.34927c(89090324)	10.36125c(89090324)	11.74301c(89090324)	11.60319c(89090324)	11.70385c(89041624)
3650800.0	7.93780c(89090324)	9.87613c(89090324)	12.42762c(89090324)	13.74130c(89090324)	13.69777c(89090324)
3650700.0	8.00220c(89090324)	9.35283c(89090324)	11.68022c(89090324)	14.60088c(89090324)	16.12028c(89090324)
3650600.0	8.11121c(89090324)	8.93800c(89090324)	11.11771c(89090324)	13.93925c(89090324)	17.34408c(89090324)
3650500.0	9.12741c(89102224)	10.03690c(89102224)	11.18166c(89030824)	13.43549c(89111224)	16.79955c(89111224)
3650400.0	11.19566c(89102224)	12.20313c(89102224)	13.00350c(89102224)	15.18746c(89111224)	18.74703c(89111224)
3650300.0	12.56787c(89102224)	13.70557c(89102224)	15.10066c(89102224)	17.07467c(89102224)	20.44965c(89102224)
3650200.0	13.61028c(89102224)	15.00438c(89102224)	17.42847c(89102224)	20.41281c(89102224)	25.09855c(89102224)
3650100.0	14.95605c(89102224)	16.56729c(89102224)	18.97676c(89102224)	23.07898c(89102224)	30.04318c(89102224)
3650000.0	15.28308c(89102224)	17.71223c(89102224)	20.72801c(89102224)	25.60961c(89102224)	37.69125c(89111724)
3649900.0	17.13569c(89102224)	20.99364c(89102224)	24.20752c(89102224)	34.03451c(89111724)	38.99410c(89111724)
3649800.0	15.22716c(89111724)	18.70209c(89111724)	24.03295c(89111724)	29.02425c(89111724)	34.01680c(89011424)
3649700.0	16.27082c(89111724)	19.46166c(89111724)	23.45321c(89111724)	26.32735c(89011424)	31.55609c(89011424)
3649600.0	16.99635c(89111724)	19.59085c(89111724)	22.06490c(89011424)	25.01722c(89011424)	28.71628c(89011424)
3649500.0	17.08472c(89111724)	19.29825c(89111724)	21.46556c(89011424)	24.09158c(89011424)	23.86091c(89011424)
3649400.0	17.43210c(89111724)	19.18732c(89011424)	20.82384c(89011424)	19.36991c(89011424)	20.59503c(89012124)
3649300.0	17.21575c(89011424)	18.01587c(89011424)	16.33552c(89011424)	18.31283c(89012124)	18.42870c(89012124)
3649200.0	15.65046c(89011424)	14.42632c(89012124)	15.91566c(89012124)	16.96532c(89012124)	16.74093c(89011424)
3649100.0	13.20583c(89012124)	14.15766c(89012124)	15.21826c(89012124)	14.76428c(89012124)	16.43493c(89012124)
3649000.0	12.94408c(89012124)	13.60740c(89012124)	13.53216c(89012124)	14.50671c(89012124)	15.15850c(89012124)

**MODELOPTs: CONC RURAL ELEV DFAULT

*** THE 1ST HIGHEST 24-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): ANSILOLD, LIMELOAD, JAWCRUSH, PULVERIZ, DIESGENR, HEAPAREA, WASTESP1,
WASTESP2, WASTESP3, WASTESP4, WASTESP5, HAULRD1 , HAULRD2 , HAULRD3 , HAULRD4 , HAULRD5 , HAULRD6 , HAULRD7 , HAULRD8 ,
HAULRD9 , HAULRD10, HAULRD11, HAULRD12, HAULRD13, HAULRD14, HAULRD15, DELIRD1 , DELIRD2 , DELIRD3 , DELIRD4 , . . . ,

*** NETWORK ID: CART1 ; NETWORK TYPE: GRIDCART ***

** CONC OF PM10 IN MICROGRAMS/M**3 **

Y-COORD (METERS)	X-COORD (METERS) 705500.00	705600.00	705700.00	705800.00	705900.00
3651000.0	12.77459c(89041624)	15.26162c(89010524)	17.48417c(89010524)	17.81117c(89010524)	16.51071c(89010524)
3650900.0	13.66575c(89041624)	16.73318c(89031524)	19.58833c(89031524)	19.46916c(89010524)	19.12675c(89010524)
3650800.0	14.24291c(89041624)	17.62190c(89031524)	22.73318c(89031524)	23.98793c(89031524)	22.69112c(89010524)
3650700.0	17.12551c(89090324)	18.61300c(89090324)	25.04912c(89031524)	33.60595c(89070224)	28.83020c(89070224)
3650600.0	19.28723c(89090324)	22.30416c(89090324)	28.04291c(89031524)	35.70088c(89070224)	35.21356c(89070224)
3650500.0	21.17496c(89090324)	25.25554c(89090324)	36.72687c(89111224)	35.28235c(89111224)	35.62468c(89070224)
3650400.0	23.42216c(89111224)	34.92009c(89111224)	40.02839c(89111224)	38.37701c(89111224)	36.03294c(89111224)
3650300.0	26.93649c(89102224)	38.80281c(89111224)	40.59666c(89111224)	39.53793c(89111224)	40.50274c(89111224)
3650200.0	34.81593c(89111224)	37.77834c(89111224)	39.13202c(89111224)	41.83863c(89111224)	41.87944c(89111224)
3650100.0	36.25378c(89111724)	36.40998c(89111724)	36.61705c(89111224)	40.21529c(89111224)	41.15942c(89111224)
3650000.0	38.59201c(89111724)	38.57860c(89111724)	39.49065c(89011424)	40.77140c(89111724)	46.33098c(89100624)
3649900.0	39.92028c(89011424)	41.42389c(89011424)	39.63130c(89011424)	43.82170c(89011424)	62.13649c(89011424)
3649800.0	40.31135c(89011424)	42.24203c(89011424)	38.88556c(89011424)	44.12493c(89011424)	38.85243c(89011424)
3649700.0	34.22336c(89011424)	34.51820c(89011424)	31.87580c(89011424)	31.52910c(89012124)	31.00233c(89011424)
3649600.0	29.59466c(89011424)	26.07064c(89011424)	26.29115c(89012124)	26.84388c(89012124)	24.63334c(89011424)
3649500.0	24.18079c(89012824)	22.60650c(89012124)	23.90858c(89012124)	21.60195c(89011424)	23.23729c(89012124)
3649400.0	20.75849c(89012124)	20.79954c(89012124)	19.07959c(89012124)	17.94058c(89110624)	22.56859c(89012124)
3649300.0	18.98354c(89011424)	19.21504c(89012124)	15.72879c(89011424)	21.27383c(89012124)	18.30565c(89011424)
3649200.0	18.30921c(89012124)	14.91791c(89012124)	17.05490c(89012124)	17.72011c(89012124)	15.95082c(89022324)
3649100.0	15.48458c(89012124)	14.05652c(89012124)	18.27121c(89012124)	14.07695c(89011424)	15.33419c(89022324)
3649000.0	13.22085c(89012124)	15.93163c(89012124)	14.10161c(89012124)	14.00666c(89012124)	14.37108c(89022324)

**MODELOPTs: CONC RURAL ELEV DFAULT

*** THE 1ST HIGHEST 24-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): ANSILOLD, LIMELOAD, JAWCRUSH, PULVERIZ, DIESGENR, HEAPAREA, WASTESP1, WASTESP2, WASTESP3, WASTESP4, WASTESP5, HAULRD1 , HAULRD2 , HAULRD3 , HAULRD4 , HAULRD5 , HAULRD6 , HAULRD7 , HAULRD8 , HAULRD9 , HAULRD10, HAULRD11, HAULRD12, HAULRD13, HAULRD14, HAULRD15, DELIRD1 , DELIRD2 , DELIRD3 , DELIRD4 , - - - ,

*** NETWORK ID: CART1 ; NETWORK TYPE: GRIDCART ***

** CONC OF PM10 IN MICROGRAMS/M**3 **

Y-COORD (METERS)	X-COORD (METERS) 706000.00
3651000.0	16.73123c(89101324)
3650900.0	16.55946c(89010524)
3650800.0	20.09077c(89021424)
3650700.0	23.49751c(89040924)
3650600.0	32.92046c(89012724)
3650500.0	36.35865c(89012724)
3650400.0	35.81491c(89111224)
3650300.0	37.44491c(89111224)
3650200.0	38.97372c(89111224)
3650100.0	39.48846c(89092424)
3650000.0	61.25609c(89092424)
3649900.0	51.10337c(89011424)
3649800.0	37.19992c(89011424)
3649700.0	27.00159c(89011924)
3649600.0	26.01496c(89012124)
3649500.0	21.25859c(89012824)
3649400.0	21.21828c(89011424)
3649300.0	19.62256c(89022324)
3649200.0	18.42785c(89022324)
3649100.0	15.13802c(89012824)
3649000.0	12.97248c(89012824)

**MODELOPTs: CONC RURAL ELEV DFAULT

*** THE SUMMARY OF HIGHEST 24-HR RESULTS ***

** CONC OF PM10 IN MICROGRAMS/M**3 **

GROUP ID	AVERAGE CONC	DATE (YYMMDDHH)	RECEPTOR (XR, YR, ZELEV, ZFLAG)	OF TYPE	NETWORK GRID-ID
ALL	HIGH 1ST HIGH VALUE IS 62.13649c	ON 89011424:	AT (705900.00, 3649900.00, 234.48, .00)	GC	CART1

*** RECEPTOR TYPES: GC = GRIDCART
GP = GRIDPOLR
DC = DISCCART
DP = DISCPOLR
BD = BOUNDARY

**MODELOPTs: CONC RURAL ELEV DEFAULT

*** Message Summary : ISCST3 Model Execution ***

--------- Summary of Total Messages --------

A Total of 0 Fatal Error Message(s)
A Total of 1 Warning Message(s)
A Total of 875 Informational Message(s)

A Total of 875 Calm Hours Identified

******** FATAL ERROR MESSAGES ********
*** NONE ***

******** WARNING MESSAGES ********
SO W320 65 PPARM :Source Parameter May Be Out-of-Range for Parameter QS

****
*** ISCST3 Finishes Successfully ***
****

APPENDIX L-4

Average Annual PM_{10} Concentrations
100 Meter Receptor Grid

```
1                    ISCST3 - (DATED 96113)

          IBM-PC VERSION (3.00)   ISCST3R
      (C) COPYRIGHT 1992-1996, TRINITY CONSULTANTS, INC.

 Run Began on  8/09/1996 at 21:59:02


 ** BREEZE AIR ISCST3 - C:\TRINITY\0959X139.DAT
 ** Trinity Consultants Incorporated, Dallas, TX

 CO STARTING
 CO TITLEONE  IMPERIAL PROJECT PM-10 IMPACT ASSESSMENT
 CO TITLETWO  AVG. ANNUAL IMPACTS - 100 METER GRID
 CO MODELOPT  DFAULT  CONC  RURAL
 CO AVERTIME  PERIOD
 CO POLLUTID  PM10
 CO TERRHGTS  ELEV
 CO RUNORNOT  RUN
 CO SAVEFILE  SAVE1.FIL  5  C:\TRINITY\0959X139.SV2
 CO ERRORFIL  ERROR.LST
 CO FINISHED

 SO STARTING
 SO ELEVUNIT  METERS
 SO LOCATION  ANSILOLD  POINT  706591.0  3650227.0  243.84
 SO LOCATION  LIMELOAD  POINT  706572.0  3650230.0  243.84
 SO LOCATION  JAWCRUSH  POINT  705358.0  3649725.0  231.65
 SO LOCATION  PULVERIZ  POINT  705344.0  3649697.0  231.65
 SO LOCATION  DIESGENR  POINT  705549.0  3649588.0  231.65
 SO LOCATION  HEAPAREA  AREA  706070.0  3649505.0  274.32
 SO LOCATION  WASTESP1  AREA  705324.0  3649918.0  289.56
 SO LOCATION  WASTESP2  AREA  705727.0  3649955.0  289.56
 SO LOCATION  WASTESP3  AREA  705969.0  3650067.0  289.56
 SO LOCATION  WASTESP4  AREA  706081.0  3650067.0  289.56
 SO LOCATION  WASTESP5  AREA  705936.0  3650003.0  289.56
 SO LOCATION  HAULRD1  AREA  706354.0  3650693.0  249.94
 SO LOCATION  HAULRD2  AREA  706386.0  3650629.0  249.94
 SO LOCATION  HAULRD3  AREA  706530.0  3650453.0  249.94
 SO LOCATION  HAULRD4  AREA  706450.0  3650405.0  249.94
 SO LOCATION  HAULRD5  AREA  706337.0  3650260.0  259.08
 SO LOCATION  HAULRD6  AREA  706225.0  3650068.0  274.32
 SO LOCATION  HAULRD7  AREA  706065.0  3650020.0  281.94
 SO LOCATION  HAULRD8  AREA  705904.0  3649971.0  289.56
 SO LOCATION  HAULRD9  AREA  706556.0  3650468.0  243.84
 SO LOCATION  HAULRD10  AREA  706562.0  3650285.0  243.84
 SO LOCATION  HAULRD11  AREA  706482.0  3650116.0  243.84
 SO LOCATION  HAULRD12  AREA  706418.0  3649939.0  243.84
 SO LOCATION  HAULRD13  AREA  706386.0  3649923.0  243.84
 SO LOCATION  HAULRD14  AREA  706229.0  3649812.0  243.84
 SO LOCATION  HAULRD15  AREA  706128.0  3649658.0  243.84
 SO LOCATION  DELIRD1  AREA  705010.0  3649832.0  243.84
 SO LOCATION  DELIRD2  AREA  705083.0  3649923.0  243.84
 SO LOCATION  DELIRD3  AREA  705240.0  3649830.0  243.84
 SO LOCATION  DELIRD4  AREA  705407.0  3649734.0  243.84
 SO LOCATION  DELIRD5  AREA  705544.0  3649641.0  243.84
 SO LOCATION  DELIRD6  AREA  705690.0  3649761.0  243.84
 SO LOCATION  DELIRD7  AREA  705825.0  3649872.0  243.84
 SO LOCATION  DELIRD8  AREA  705987.0  3649879.0  243.84
 SO LOCATION  DELIRD9  AREA  706146.0  3649953.0  243.84
 SO LOCATION  DELIRD10  AREA  706303.0  3650027.0  243.84
 SO LOCATION  DELIRD11  AREA  706400.0  3650194.0  243.84
 SO LOCATION  DELIRD12  AREA  706464.0  3650308.0  243.84
 SO LOCATION  DELIRD13  AREA  706528.0  3650420.0  243.84
 SO LOCATION  LIMEAPPL  AREA  706555.0  3650237.0  243.84
 SO LOCATION  LIMENOPP  AREA  706571.0  3650231.0  243.84
 SO LOCATION  ANSILOUN  AREA  706590.0  3650227.0  243.84
 SO LOCATION  WESTPIT  OPENPIT  705777.0  3651283.0  249.94
 SO SRCPARAM  ANSILOLD  7.87500000E-04  22.16  299.81  8.17  0.20
 SO SRCPARAM  LIMELOAD  2.12625000E-04  22.16  299.81  8.17  0.20
 SO SRCPARAM  JAWCRUSH  3.80525000E-04  4.57  299.81  0.01  1.83
 SO SRCPARAM  PULVERIZ  3.80525000E-04  1.52  299.81  0.01  1.83
 SO SRCPARAM  DIESGENR  2.03112000E-04  3.05  322.04  21.34  0.20
 SO SRCPARAM  HEAPAREA  7.99552000E-07  0.00  700.00  273.98  30.0  4.56
 SO SRCPARAM  WASTESP1  7.92692000E-07  0.00  333.33  916.69  30.0  5.07
 SO SRCPARAM  WASTESP2  7.92692000E-07  0.00  160.42  641.68  30.0  5.07
 SO SRCPARAM  WASTESP3  7.92692000E-07  0.00  96.25  417.09  30.0  5.07
 SO SRCPARAM  WASTESP4  7.92692000E-07  0.00  48.12  304.80  30.0  5.07
 SO SRCPARAM  WASTESP5  7.92692000E-07  0.00  64.17  64.17  30.0  5.07
 SO SRCPARAM  HAULRD1  1.04105000E-05  0.00  30.48  192.51  -15.0  5.91
 SO SRCPARAM  HAULRD2  1.04105000E-05  0.00  30.48  48.12  -30.0  5.91
 SO SRCPARAM  HAULRD3  1.04105000E-05  0.00  30.48  224.59  -40.0  5.91
 SO SRCPARAM  HAULRD4  8.19647000E-06  0.00  30.48  80.21  31.0  5.86
 SO SRCPARAM  HAULRD5  8.19647000E-06  0.00  30.48  192.51  35.0  5.86
 SO SRCPARAM  HAULRD6  8.19647000E-06  0.00  30.48  208.55  30.0  5.86
 SO SRCPARAM  HAULRD7  8.19647000E-06  0.00  30.48  144.38  75.0  5.86
 SO SRCPARAM  HAULRD8  8.19647000E-06  0.00  30.48  144.38  72.0  5.86
 SO SRCPARAM  HAULRD9  2.75168000E-06  0.00  30.48  112.29  150.0  5.38
 SO SRCPARAM  HAULRD10  2.84175000E-06  0.00  30.48  96.25  20.0  5.31
 SO SRCPARAM  HAULRD11  2.75168000E-06  0.00  30.48  208.55  20.0  5.38
 SO SRCPARAM  HAULRD12  2.75168000E-06  0.00  30.48  176.46  20.0  5.38
 SO SRCPARAM  HAULRD13  1.38110000E-06  0.00  30.48  32.08  55.0  4.71
 SO SRCPARAM  HAULRD14  2.75168000E-06  0.00  30.48  192.51  55.0  5.38
 SO SRCPARAM  HAULRD15  2.75168000E-06  0.00  30.48  192.51  30.0  5.38
 SO SRCPARAM  DELIRD1  6.27708000E-07  0.00  9.14  91.40  30.0  2.52
 SO SRCPARAM  DELIRD2  6.27708000E-07  0.00  9.14  91.40  119.0  2.52
```



```
 SO SRCPARAM  DELIRD3  6.27708000E-07  0.00  9.14  91.40  119.0  2.52
 SO SRCPARAM  DELIRD4  6.27708000E-07  0.00  9.14  91.40  119.0  2.52
 SO SRCPARAM  DELIRD5  6.27708000E-07  0.00  9.14  91.40  50.0  2.52
 SO SRCPARAM  DELIRD6  6.27708000E-07  0.00  9.14  91.40  50.0  2.52
 SO SRCPARAM  DELIRD7  6.27708000E-07  0.00  9.14  91.40  88.0  2.52
 SO SRCPARAM  DELIRD8  6.27708000E-07  0.00  9.14  91.40  64.0  2.52
 SO SRCPARAM  DELIRD9  6.27708000E-07  0.00  9.14  91.40  64.0  2.52
 SO SRCPARAM  DELIRD10  6.27708000E-07  0.00  9.14  91.40  30.0  2.52
 SO SRCPARAM  DELIRD11  6.27708000E-07  0.00  9.14  91.40  30.0  2.52
 SO SRCPARAM  DELIRD12  6.27708000E-07  0.00  9.14  91.40  29.0  2.52
 SO SRCPARAM  DELIRD13  6.27708000E-07  0.00  9.14  64.17  110.0  2.52
 SO SRCPARAM  LIMEAPPL  3.81064000E-05  0.00  1.52  3.05  30.0  6.10
 SO SRCPARAM  LIMENOPP  3.76736900E-03  0.00  0.91  0.91  30.0  6.10
 SO SRCPARAM  ANSILOUN  9.41842000E-04  0.00  0.91  0.91  0.0  3.05
 SO SRCPARAM  WESTPIT  1.41537000E-06  6.00  581.86  581.86  62100000.0  30.0
 SO PARTDIAM  WESTPIT  10
 SO MASSFRAX  WESTPIT  1
 SO PARTDENS  WESTPIT  2.5
 SO CONCUNIT  1.00E+06  GRAMS/SEC  MICROGRAMS/M**3
 SO SRCGROUP  ALL
 SO FINISHED

 RE STARTING
 RE ELEVUNIT  FEET
 RE GRIDCART CART1 STA
 RE GRIDCART CART1 XYINC  705000  11  100  3649000  21  100
 RE GRIDCART CART1 ELEV  1  729.3  729.0  729.0  732.3  733.0  733.2  733.0
 RE GRIDCART CART1 ELEV  1  736.2  738.6  739.0  744.0
 RE GRIDCART CART1 ELEV  2  731.0  730.0  730.0  733.7  734.0  734.0  734.0
 RE GRIDCART CART1 ELEV  2  737.2  740.2  740.0  745.1
 RE GRIDCART CART1 ELEV  3  732.0  732.0  732.0  735.0  736.0  736.0  736.0
 RE GRIDCART CART1 ELEV  3  739.3  742.7  743.0  747.0
 RE GRIDCART CART1 ELEV  4  739.3  738.8  738.0  741.3  742.2  741.6  741.3
 RE GRIDCART CART1 ELEV  4  744.8  748.4  748.3  751.6
 RE GRIDCART CART1 ELEV  5  742.3  741.2  740.8  745.0  744.8  744.2  744.7
 RE GRIDCART CART1 ELEV  5  747.8  752.0  752.7  755.8
 RE GRIDCART CART1 ELEV  6  738.0  738.0  737.7  742.0  744.0  744.0  745.0
 RE GRIDCART CART1 ELEV  6  749.3  754.3  756.0  755.0
 RE GRIDCART CART1 ELEV  7  745.0  739.2  736.4  739.7  743.0  744.6  747.0
 RE GRIDCART CART1 ELEV  7  753.6  755.9  768.0  753.3
 RE GRIDCART CART1 ELEV  8  741.0  738.9  739.0  745.0  747.6  748.2  750.7
 RE GRIDCART CART1 ELEV  8  756.6  768.6  771.7  761.5
 RE GRIDCART CART1 ELEV  9  755.0  748.3  742.3  741.0  743.7  746.7  751.0
 RE GRIDCART CART1 ELEV  9  760.0  761.7  782.0  775.6
 RE GRIDCART CART1 ELEV  10  767.7  749.9  746.0  755.7  759.0  755.2  756.3
 RE GRIDCART CART1 ELEV  10  761.8  764.8  769.3  767.6
 RE GRIDCART CART1 ELEV  11  784.7  760.4  753.8  773.0  769.0  758.0  757.0
 RE GRIDCART CART1 ELEV  11  751.6  766.2  769.7  767.8
 RE GRIDCART CART1 ELEV  12  806.0  771.7  758.7  772.0  765.0  757.3  759.0
 RE GRIDCART CART1 ELEV  12  758.0  769.0  772.0  770.0
 RE GRIDCART CART1 ELEV  13  794.0  776.4  773.4  775.7  776.6  776.0  773.7
 RE GRIDCART CART1 ELEV  13  772.8  779.6  780.0  777.1
 RE GRIDCART CART1 ELEV  14  777.0  768.8  766.8  768.3  773.9  776.8  775.0
 RE GRIDCART CART1 ELEV  14  774.0  779.6  780.3  778.3
 RE GRIDCART CART1 ELEV  15  781.0  781.0  780.7  784.0  791.3  799.7  794.0
 RE GRIDCART CART1 ELEV  15  790.7  792.3  790.0  786.0
 RE GRIDCART CART1 ELEV  16  775.7  781.8  781.6  784.0  788.9  799.4  802.7
 RE GRIDCART CART1 ELEV  16  795.8  790.2  784.3  785.5
 RE GRIDCART CART1 ELEV  17  772.7  784.8  784.0  785.0  786.5  792.6  801.3
 RE GRIDCART CART1 ELEV  17  806.5  802.2  797.7  792.8
 RE GRIDCART CART1 ELEV  18  769.0  780.0  780.0  782.0  781.7  783.0  795.0
 RE GRIDCART CART1 ELEV  18  804.0  808.0  802.0  795.9
 RE GRIDCART CART1 ELEV  19  780.0  783.3  781.7  780.3  778.6  774.5  790.3
 RE GRIDCART CART1 ELEV  19  784.6  808.3  808.3  802.2
 RE GRIDCART CART1 ELEV  20  807.7  795.0  788.0  781.3  774.9  773.0  786.7
 RE GRIDCART CART1 ELEV  20  803.2  799.4  816.3  815.8
 RE GRIDCART CART1 ELEV  21  860.0  825.0  793.3  780.0  780.7  778.3  781.0
 RE GRIDCART CART1 ELEV  21  806.3  808.3  809.0  821.7
 RE GRIDCART CART1 END
 RE FINISHED

 ME STARTING
 ME INPUTFIL  C:\TRINITY\YUMTUS89.ASC
 ME ANEMHGHT  10.0  METERS
 ME SURFDATA  3145  1989
 ME UAIRDATA  23160  1989
 ME STARTEND  89  01  01  1  89  12  31  24
 ME FINISHED

 OU STARTING
 OU FINISHED

 **********************************
 *** SETUP Finishes Successfully ***
 **********************************
```

**MODELOPTs: CONC RURAL ELEV DEFAULT

*** MODEL SETUP OPTIONS SUMMARY ***

**Intermediate Terrain Processing is Selected

**Model Is Setup For Calculation of Average CONCentration Values.

  -- SCAVENGING/DEPOSITION LOGIC --
**Model Uses NO DRY DEPLETION. DDPLETE = F
**Model Uses NO WET DEPLETION. WDPLETE = F
**NO WET SCAVENGING Data Provided.
**Model Does NOT Use GRIDDED TERRAIN Data for Depletion Calculations

**Model Uses RURAL Dispersion.

**Model Uses Regulatory DEFAULT Options:
        1. Final Plume Rise.
        2. Stack-tip Downwash.
        3. Buoyancy-induced Dispersion.
        4. Use Calms Processing Routine.
        5. Not Use Missing Data Processing Routine.
        6. Default Wind Profile Exponents.
        7. Default Vertical Potential Temperature Gradients.
        8. "Upper Bound" Values for Supersquat Buildings.
        9. No Exponential Decay for RURAL Mode

**Model Accepts Receptors on ELEV Terrain.

**Model Assumes No FLAGPOLE Receptor Heights.

**Model Calculates PERIOD Averages Only

**This Run Includes: 43 Source(s); 1 Source Group(s); and 231 Receptor(s)

**The Model Assumes A Pollutant Type of: PM10

**Model Set To Continue RUNning After the Setup Testing.

**Output Options Selected:
        Model Outputs Tables of PERIOD Averages by Receptor

**NOTE: The Following Flags May Appear Following CONC Values: c for Calm Hours
                                                                m for Missing Hours
                                                                b for Both Calm and Missing Hours

**Misc. Inputs: Anem. Hgt. (m) = 10.00 ; Decay Coef. = .0000 ; Rot. Angle = .0
                 Emission Units = GRAMS/SEC ; Emission Rate Unit Factor = .10000E+07
                 Output Units = MICROGRAMS/M**3

**Input Runstream File: C:\TRINITY\0959XI39.DAT ; **Output Print File: C:\TRINITY\0959XI39.LST
**File for Saving Result Arrays: SAVE1.FIL
**Detailed Error/Message File: ERROR.LST

**MODELOPTs: CONC RURAL ELEV DEFAULT

*** POINT SOURCE DATA ***

SOURCE ID	NUMBER PART. CATS.	EMISSION RATE (GRAMS/SEC)	X (METERS)	Y (METERS)	BASE ELEV. (METERS)	STACK HEIGHT (METERS)	STACK TEMP. (DEG.K)	STACK EXIT VEL. (M/SEC)	STACK DIAMETER (METERS)	BUILDING EXISTS	EMISSION RATE SCALAR VARY BY
ANSILOLD	0	.78750E-03	706591.0	3650227.0	243.8	22.16	299.81	8.17	.20	NO	
LIMELOAD	0	.21263E-03	706572.0	3650230.0	243.8	22.16	299.81	8.17	.20	NO	
JAWCRUSH	0	.38053E-03	705358.0	3649725.0	231.7	4.57	299.81	.01	1.83	NO	
PULVERIZ	0	.38053E-03	705344.0	3649697.0	231.7	1.52	299.81	.01	1.83	NO	
DIESGENR	0	.20311E-03	705549.0	3649588.0	231.7	3.05	322.04	21.34	.20	NO	

**MODELOPTs: CONC RURAL ELEV DFAULT

*** AREA SOURCE DATA ***

SOURCE ID	NUMBER PART. CATS.	EMISSION RATE (GRAMS/SEC /METER**2)	COORD (SW CORNER) X (METERS)	Y (METERS)	BASE ELEV. (METERS)	RELEASE HEIGHT (METERS)	X-DIM OF AREA (METERS)	Y-DIM OF AREA (METERS)	ORIENT. OF AREA (DEG.)	INIT. SZ (METERS)	EMISSION RATE SCALAR VARY BY
HEAPAREA	0	.79955E-06	706070.0	3649505.0	274.3	.00	700.00	273.98	30.00	4.56	
WASTESP1	0	.79269E-06	705324.0	3649918.0	289.6	.00	333.33	916.69	30.00	5.07	
WASTESP2	0	.79269E-06	705727.0	3649955.0	289.6	.00	160.42	641.68	30.00	5.07	
WASTESP3	0	.79269E-06	705969.0	3650067.0	289.6	.00	96.25	417.09	30.00	5.07	
WASTESP4	0	.79269E-06	706081.0	3650067.0	289.6	.00	48.12	304.80	30.00	5.07	
WASTESP5	0	.79269E-06	705936.0	3650003.0	289.6	.00	64.17	64.17	30.00	5.07	
HAULRD1	0	.10410E-04	706354.0	3650693.0	249.9	.00	30.48	192.51	-15.00	5.91	
HAULRD2	0	.10410E-04	706386.0	3650629.0	249.9	.00	30.48	48.12	-30.00	5.91	
HAULRD3	0	.10410E-04	706530.0	3650453.0	249.9	.00	30.48	224.59	-40.00	5.91	
HAULRD4	0	.81965E-05	706450.0	3650405.0	249.9	.00	30.48	80.21	31.00	5.86	
HAULRD5	0	.81965E-05	706337.0	3650260.0	259.1	.00	30.48	192.51	35.00	5.86	
HAULRD6	0	.81965E-05	706225.0	3650068.0	274.3	.00	30.48	208.55	30.00	5.86	
HAULRD7	0	.81965E-05	706065.0	3650020.0	281.9	.00	30.48	144.38	75.00	5.86	
HAULRD8	0	.81965E-05	705904.0	3649971.0	289.6	.00	30.48	144.38	72.00	5.86	
HAULRD9	0	.27517E-05	706556.0	3650468.0	243.8	.00	30.48	112.29	150.00	5.38	
HAULRD10	0	.28417E-05	706562.0	3650285.0	243.8	.00	30.48	96.25	20.00	5.31	
HAULRD11	0	.27517E-05	706482.0	3650116.0	243.8	.00	30.48	208.55	20.00	5.38	
HAULRD12	0	.27517E-05	706418.0	3649939.0	243.8	.00	30.48	176.46	20.00	5.38	
HAULRD13	0	.13811E-05	706386.0	3649923.0	243.8	.00	30.48	32.08	55.00	4.71	
HAULRD14	0	.27517E-05	706229.0	3649812.0	243.8	.00	30.48	192.51	55.00	5.38	
HAULRD15	0	.27517E-05	706128.0	3649658.0	243.8	.00	30.48	192.51	30.00	5.38	
DELIRD1	0	.62771E-06	705010.0	3649832.0	243.8	.00	9.14	91.40	30.00	2.52	
DELIRD2	0	.62771E-06	705083.0	3649923.0	243.8	.00	9.14	91.40	119.00	2.52	
DELIRD3	0	.62771E-06	705240.0	3649830.0	243.8	.00	9.14	91.40	119.00	2.52	
DELIRD4	0	.62771E-06	705407.0	3649734.0	243.8	.00	9.14	91.40	119.00	2.52	
DELIRD5	0	.62771E-06	705544.0	3649641.0	243.8	.00	9.14	91.40	50.00	2.52	
DELIRD6	0	.62771E-06	705690.0	3649761.0	243.8	.00	9.14	91.40	50.00	2.52	
DELIRD7	0	.62771E-06	705825.0	3649872.0	243.8	.00	9.14	91.40	88.00	2.52	
DELIRD8	0	.62771E-06	705987.0	3649879.0	243.8	.00	9.14	91.40	64.00	2.52	
DELIRD9	0	.62771E-06	706146.0	3649953.0	243.8	.00	9.14	91.40	64.00	2.52	
DELIRD10	0	.62771E-06	706303.0	3650027.0	243.8	.00	9.14	91.40	30.00	2.52	
DELIRD11	0	.62771E-06	706400.0	3650194.0	243.8	.00	9.14	91.40	30.00	2.52	
DELIRD12	0	.62771E-06	706464.0	3650308.0	243.8	.00	9.14	91.40	29.00	2.52	
DELIRD13	0	.62771E-06	706528.0	3650420.0	243.8	.00	9.14	64.17	110.00	2.52	
LIMEAPPL	0	.38106E-04	706555.0	3650237.0	243.8	.00	1.52	3.05	30.00	6.10	
LIMEHOPP	0	.37674E-02	706571.0	3650231.0	243.8	.00	.91	.91	30.00	6.10	
ANSILOUN	0	.94184E-03	706590.0	3650227.0	243.8	.00	.91	.91	.00	3.05	

**MODELOPTs: CONC RURAL ELEV DFAULT

*** OPENPIT SOURCE DATA ***

SOURCE ID	NUMBER PART. CATS.	EMISSION RATE (GRAMS/SEC /METER**2)	COORD (SW CORNER) X (METERS)	Y (METERS)	BASE ELEV. (METERS)	RELEASE HEIGHT (METERS)	X-DIM OF PIT (METERS)	Y-DIM OF PIT (METERS)	ORIENT. OF PIT (DEG.)	VOLUME OF PIT (M**3)	EMISSION RATE SCALAR VARY BY
WESTPIT	1	.14154E-05	705777.0	3651283.0	249.9	6.00	581.86	581.86	30.00	.62100E+08	

**MODELOPTs: CONC RURAL ELEV DFAULT

*** SOURCE IDs DEFINING SOURCE GROUPS ***

GROUP ID	SOURCE IDs
ALL	ANSILOLD, LIMELOAD, JAWCRUSH, PULVERIZ, DIESGENR, HEAPAREA, WASTESP1, WASTESP2, WASTESP3, WASTESP4, WASTESP5, HAULRD1 , HAULRD2 , HAULRD3 , HAULRD4 , HAULRD5 , HAULRD6 , HAULRD7 , HAULRD8 , HAULRD9 , HAULRD10, HAULRD11, HAULRD12, HAULRD13, HAULRD14, HAULRD15, DELIRD1 , DELIRD2 , DELIRD3 , DELIRD4 , DELIRD5 , DELIRD6 , DELIRD7 , DELIRD8 , DELIRD9 , DELIRD10, DELIRD11, DELIRD12, DELIRD13, LIMEAPPL, LIMEHOPP, ANSILOUN, WESTPIT ,

**MODELOPTs: CONC RURAL ELEV DFAULT

*** SOURCE PARTICULATE/GAS DATA ***

*** SOURCE ID = WESTPIT ; SOURCE TYPE = OPENPIT ***

MASS FRACTION =
  1.00000,

PARTICLE DIAMETER (MICRONS) =
 10.60000,

PARTICLE DENSITY (G/CM**3) =
  2.50000,

**MODELOPTs: CONC RURAL ELEV DFAULT

*** GRIDDED RECEPTOR NETWORK SUMMARY ***

*** NETWORK ID: CART1 ; NETWORK TYPE: GRIDCART ***

*** X-COORDINATES OF GRID ***
(METERS)

705000.0, 705100.0, 705200.0, 705300.0, 705400.0, 705500.0, 705600.0, 705700.0, 705800.0, 705900.0,
706000.0,

*** Y-COORDINATES OF GRID ***
(METERS)

3649000.0, 3649100.0, 3649200.0, 3649300.0, 3649400.0, 3649500.0, 3649600.0, 3649700.0, 3649800.0, 3649900.0,
3650000.0, 3650100.0, 3650200.0, 3650300.0, 3650400.0, 3650500.0, 3650600.0, 3650700.0, 3650800.0, 3650900.0,
3651000.0,

**MODELOPTs: CONC RURAL ELEV DFAULT

*** NETWORK ID: CART1 ; NETWORK TYPE: GRIDCART ***

* ELEVATION HEIGHTS IN METERS *

Y-COORD (METERS)	X-COORD (METERS) 705000.00	705100.00	705200.00	705300.00	705400.00	705500.00	705600.00	705700.00	705800.00
3651000.00	262.13	251.46	241.80	237.74	237.96	237.23	238.05	245.76	246.37
3650900.00	246.19	242.32	240.18	238.14	236.19	235.61	239.79	244.82	243.66
3650800.00	237.74	238.75	238.26	237.84	237.32	236.07	240.88	239.15	246.37
3650700.00	234.39	237.74	237.74	238.35	238.26	238.66	242.32	245.06	246.28
3650600.00	235.52	239.21	238.96	239.27	239.73	241.58	244.24	245.82	244.51
3650500.00	236.43	238.29	238.23	238.96	240.46	243.66	244.66	242.56	240.85
3650400.00	238.05	238.05	237.96	238.96	241.19	243.75	242.01	241.01	241.49
3650300.00	236.83	234.33	233.72	234.18	235.88	236.77	236.22	235.92	237.62
3650200.00	242.01	236.65	235.73	236.43	236.71	236.52	235.82	235.55	237.62
3650100.00	245.67	235.21	231.25	235.31	233.17	230.83	231.34	231.04	234.39
3650000.00	239.18	231.77	229.76	235.61	234.39	231.04	230.73	229.09	233.54
3649900.00	233.99	228.57	227.38	230.34	231.34	230.18	230.52	232.20	233.11
3649800.00	230.12	228.08	226.25	225.86	226.68	227.59	228.90	231.65	232.17
3649700.00	225.86	225.22	225.25	227.08	227.87	228.05	228.81	230.61	234.27
3649600.00	227.08	225.31	224.45	225.46	226.47	226.95	227.69	229.70	230.40
3649500.00	224.94	224.94	224.85	226.16	226.77	226.77	227.08	228.39	229.91
3649400.00	226.25	225.92	225.80	227.08	227.02	226.83	226.98	227.93	229.21
3649300.00	225.34	225.19	224.94	225.95	226.22	226.04	225.95	227.02	228.11
3649200.00	223.11	223.11	223.11	224.03	224.33	224.33	224.33	225.34	226.37
3649100.00	222.81	222.50	222.50	223.63	223.72	223.72	223.72	224.70	225.61
3649000.00	222.29	222.20	222.20	223.21	223.42	223.48	223.42	224.39	225.13

**MODELOPTs: CONC RURAL ELEV DFAULT

*** NETWORK ID: CART1 ; NETWORK TYPE: GRIDCART ***

* ELEVATION HEIGHTS IN METERS *

Y-COORD (METERS)	X-COORD (METERS) 705900.00	706000.00
3651000.00	246.58	250.45
3650900.00	248.81	248.66
3650800.00	246.37	244.51
3650700.00	244.45	242.59
3650600.00	243.14	241.65
3650500.00	239.05	239.42
3650400.00	240.79	239.57
3650300.00	237.84	237.23
3650200.00	237.74	236.86
3650100.00	235.31	234.70
3650000.00	234.60	234.03
3649900.00	234.48	233.96
3649800.00	238.35	236.40
3649700.00	235.21	232.11
3649600.00	234.09	229.61
3649500.00	230.43	230.12
3649400.00	229.42	230.37
3649300.00	228.08	229.09
3649200.00	226.47	227.69
3649100.00	225.55	227.11
3649000.00	225.25	226.77

**MODELOPTs: CONC RURAL ELEV DFAULT

*** METEOROLOGICAL DAYS SELECTED FOR PROCESSING ***
(1=YES; 0=NO)

1 1 1

**MODELOPTs: CONC RURAL ELEV DFAULT

*** THE FIRST 24 HOURS OF METEOROLOGICAL DATA ***

FILE: C:\TRINITY\YUMTUS89.ASC FORMAT: (4I2,2F9.4,F6.1,I2,2F7.1,E9.4,E10.1,E8.4,I4,F7.2)
SURFACE STATION NO.: 3145 UPPER AIR STATION NO.: 23160
NAME: UNKNOWN NAME: UNKNOWN
YEAR: 1989 YEAR: 1989

YEAR	MONTH	DAY	HOUR	FLOW VECTOR	SPEED (M/S)	TEMP (K)	STAB CLASS	MIXING HEIGHT (M) RURAL	MIXING HEIGHT (M) URBAN	USTAR (M/S)	M-O LENGTH (M)	Z-0 (M)	IPCODE	PRATE (mm/HR)
89	1	1	1	241.0	1.54	279.8	7	1933.0	81.0	.0849	12.9	.2630	0	.00
89	1	1	2	218.0	1.00	277.0	7	1933.0	81.0	.0550	12.9	.2630	0	.00
89	1	1	3	234.0	1.03	277.0	7	1933.0	81.0	.0566	12.9	.2630	0	.00
89	1	1	4	223.0	2.06	276.5	6	1933.0	81.0	.1132	12.9	.2630	0	.00
89	1	1	5	163.0	1.54	275.4	7	1933.0	81.0	.0849	12.9	.2630	0	.00
89	1	1	6	.0	.00	274.8	7	1933.0	81.0	.0550	12.9	.2630	0	.00
89	1	1	7	.0	.00	275.4	7	1933.0	81.0	.0550	12.9	.2630	0	.00
89	1	1	8	213.0	1.03	274.8	6	76.2	154.0	.0566	12.9	.2630	0	.00
89	1	1	9	237.0	3.09	277.6	5	385.6	450.5	.2810	62.1	.2630	0	.00
89	1	1	10	221.0	4.12	280.9	4	695.1	747.0	.4655	-294.9	.2630	0	.00
89	1	1	11	224.0	3.60	284.3	3	1004.6	1043.5	.4299	-86.5	.2630	0	.00
89	1	1	12	216.0	3.09	286.5	3	1314.1	1340.0	.3873	-45.0	.2630	0	.00
89	1	1	13	213.0	3.09	287.6	3	1623.5	1636.5	.3904	-41.1	.2630	0	.00
89	1	1	14	219.0	4.63	288.2	3	1933.0	1933.0	.5432	-116.0	.2630	0	.00
89	1	1	15	222.0	3.60	289.3	3	1933.0	1933.0	.4342	-74.6	.2630	0	.00
89	1	1	16	214.0	4.12	289.3	3	1933.0	1933.0	.4736	-174.8	.2630	0	.00
89	1	1	17	181.0	3.09	289.8	4	1933.0	1933.0	.2841	66.3	.2630	0	.00
89	1	1	18	.0	.00	288.2	5	1910.4	1831.4	.0550	12.9	.2630	0	.00
89	1	1	19	.0	.00	284.3	6	1847.5	1548.2	.0550	12.9	.2630	0	.00
89	1	1	20	.0	.00	282.0	7	1784.6	1265.0	.0550	12.9	.2630	0	.00
89	1	1	21	200.0	1.00	280.9	7	1721.7	981.7	.0550	12.9	.2630	0	.00
89	1	1	22	.0	.00	282.6	7	1658.7	698.5	.0550	12.9	.2630	0	.00
89	1	1	23	.0	.00	279.3	7	1595.8	415.2	.0550	12.9	.2630	0	.00
89	1	1	24	230.0	3.09	279.3	6	1532.9	132.0	.2815	62.7	.2630	0	.00

*** NOTES: STABILITY CLASS 1=A, 2=B, 3=C, 4=D, 5=E AND 6=F.
FLOW VECTOR IS DIRECTION TOWARD WHICH WIND IS BLOWING.

**MODELOPTs: CONC RURAL ELEV DFAULT

*** THE PERIOD (8760 HRS) AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): ANSILOLD, LIMELOAD, JAWCRUSH, PULVERIZ, DIESGENR, HEAPAREA, WASTESP1, WASTESP2, WASTESP3, WASTESP4, WASTESP5, HAULRD1 , HAULRD2 , HAULRD3 , HAULRD4 , HAULRD5 , HAULRD6 , HAULRD7 , HAULRD8 , HAULRD9 , HAULRD10, HAULRD11, HAULRD12, HAULRD13, HAULRD14, HAULRD15, DELIRD1 , DELIRD2 , DELIRD3 , DELIRD4 , ...

*** NETWORK ID: CART1 ; NETWORK TYPE: GRIDCART ***

** CONC OF PM10 IN MICROGRAMS/M**3 **

Y-COORD (METERS)	X-COORD (METERS) 705000.00	705100.00	705200.00	705300.00	705400.00	705500.00	705600.00	705700.00	705800.00
3651000.00	1.31098	1.61327	2.00087	2.51703	3.18846	3.97355	4.72031	5.22529	5.48205
3650900.00	1.31972	1.66668	2.09854	2.66749	3.39154	4.20794	5.09524	5.95139	6.38450
3650800.00	1.33154	1.69714	2.16363	2.74609	3.50176	4.41973	5.53698	6.85756	7.80617
3650700.00	1.35754	1.73553	2.21886	2.83591	3.60766	4.66288	6.01717	7.89121	11.00793
3650600.00	1.37032	1.76148	2.27704	2.92182	3.78725	4.95706	6.71948	9.82415	13.79396
3650500.00	1.37516	1.77738	2.32082	3.01974	3.97564	5.43377	7.88399	13.29255	15.35906
3650400.00	1.38544	1.76025	2.32870	3.13948	4.32869	6.20302	10.55890	14.69542	16.39528
3650300.00	1.40778	1.73382	2.31882	3.30844	4.83055	7.60663	13.08394	15.33863	16.96418
3650200.00	1.45128	1.75663	2.33513	3.48693	5.60519	10.82055	13.86403	15.42301	16.93142
3650100.00	1.53542	1.85876	2.37918	3.71652	7.00377	12.29208	14.03239	14.99107	16.21234
3650000.00	1.63110	2.02961	2.56204	3.95037	9.50850	12.55804	13.85647	13.93285	14.78013
3649900.00	1.78284	2.57123	2.93637	4.51324	8.57551	11.47740	12.75971	11.07343	10.98827
3649800.00	1.88407	2.27880	3.04164	5.01538	5.97743	7.75305	10.33383	8.41263	8.85360
3649700.00	1.84097	2.36791	3.14400	3.99070	5.11687	6.08459	6.62817	6.45267	6.67973
3649600.00	1.98872	2.49606	3.06969	3.66580	4.25119	4.71917	5.08865	5.23574	5.43705
3649500.00	2.08590	2.50020	2.89943	3.28826	3.64126	3.95841	4.25045	4.51771	4.46759
3649400.00	2.08564	2.39908	2.69627	2.95488	3.19785	3.46014	3.70814	3.78383	3.84591
3649300.00	2.02722	2.28918	2.46784	2.64359	2.85297	3.07006	3.21571	3.21937	3.50666
3649200.00	1.98247	2.12137	2.23730	2.41323	2.59394	2.73962	2.74476	2.92409	3.13211
3649100.00	1.86056	1.94125	2.08034	2.24002	2.36068	2.38965	2.47877	2.65674	2.75810
3649000.00	1.72118	1.82987	1.96271	2.05271	2.10118	2.16260	2.28286	2.36836	2.45952

**MODELOPTs: CONC RURAL ELEV DFAULT

*** THE PERIOD (8760 HRS) AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): ANSILOLD, LIMELOAD, JAWCRUSH, PULVERIZ, DIESGENR, HEAPAREA, WASTESP1,
WASTESP2, WASTESP3, WASTESP4, WASTESP5, HAULRD1 , HAULRD2 , HAULRD3 , HAULRD4 , HAULRD5 , HAULRD6 , HAULRD7 , HAULRD8 ,
HAULRD9 , HAULRD10, HAULRD11, HAULRD12, HAULRD13, HAULRD14, HAULRD15, DELIRD1 , DELIRD2 , DELIRD3 , DELIRD4 , . . . ,

*** NETWORK ID: CART1 ; NETWORK TYPE: GRIDCART ***

** CONC OF PM10 IN MICROGRAMS/M**3 **

Y-COORD (METERS)	X-COORD (METERS) 705900.00	706000.00
3651000.00	5.59327	5.70991
3650900.00	6.33170	6.28576
3650800.00	7.66653	7.27042
3650700.00	9.96940	8.99310
3650600.00	14.20242	12.81821
3650500.00	16.15899	16.30526
3650400.00	17.37896	17.81631
3650300.00	18.13920	18.78158
3650200.00	18.45828	19.48399
3650100.00	18.36487	20.04965
3650000.00	17.83864	25.82002
3649900.00	14.20426	14.24258
3649800.00	9.27243	9.88846
3649700.00	7.03654	7.19600
3649600.00	5.41272	5.96987
3649500.00	4.67792	5.41390
3649400.00	4.28142	4.79996
3649300.00	3.76742	4.08515
3649200.00	3.27524	3.49724
3649100.00	2.86158	3.03245
3649000.00	2.52625	2.65173

**MODELOPTs: CONC RURAL ELEV DFAULT

*** THE SUMMARY OF MAXIMUM PERIOD (8760 HRS) RESULTS ***

** CONC OF PM10 IN MICROGRAMS/M**3 **

GROUP ID	AVERAGE CONC	RECEPTOR (XR, YR, ZELEV, ZFLAG)	OF TYPE	NETWORK GRID-ID
ALL	1ST HIGHEST VALUE IS 25.82002	AT (706000.00, 3650000.00, 234.03, .00)	GC	CART1
	2ND HIGHEST VALUE IS 20.04965	AT (706000.00, 3650100.00, 234.70, .00)	GC	CART1

*** RECEPTOR TYPES: GC = GRIDCART
GP = GRIDPOLR
DC = DISCCART
DP = DISCPOLR
BD = BOUNDARY

```
*** ISCST3 - VERSION 96113 ***     *** IMPERIAL PROJECT PM-10 IMPACT ASSESSMENT                    ***     08/09/96
                                   *** AVG. ANNUAL IMPACTS - 100 METER GRID                        ***     21:59:02
                                                                                                          PAGE  15

**MODELOPTs: CONC                          RURAL  ELEV          DFAULT


*** Message Summary : ISCST3 Model Execution ***

 --------- Summary of Total Messages --------

A Total of           0 Fatal Error Message(s)
A Total of           0 Warning Message(s)
A Total of         875 Informational Message(s)

A Total of         875 Calm Hours Identified


   ******** FATAL ERROR MESSAGES ********
              *** NONE ***


   ********   WARNING MESSAGES   ********
              *** NONE ***


   ***********************************
   *** ISCST3 Finishes Successfully ***
   ***********************************
```

BLM LIBRARY
RS 150A BLDG. 50
DENVER FEDERAL CENTER
P.O. BOX 25047
DENVER, CO 80225